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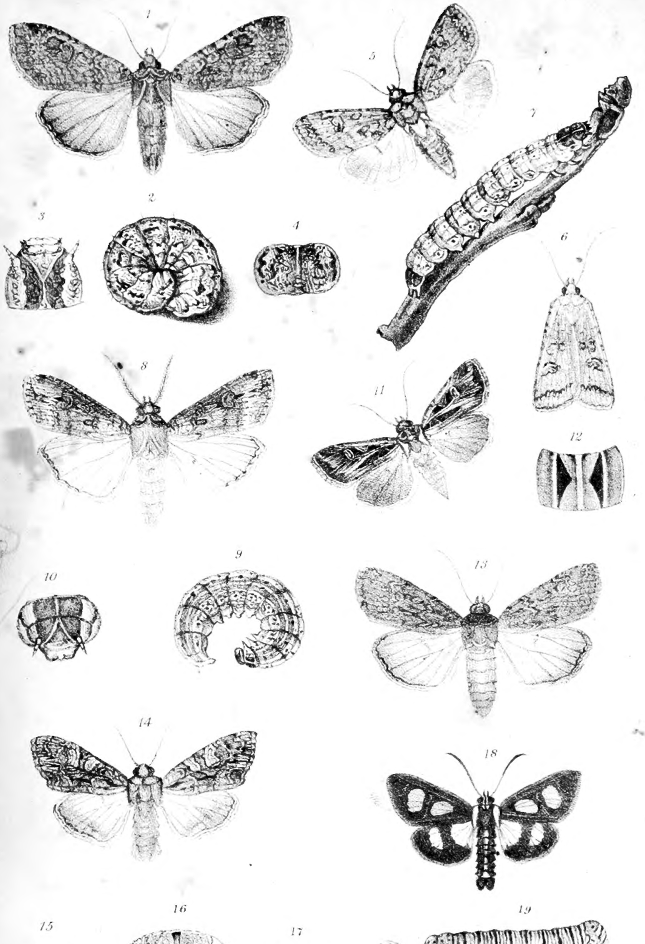

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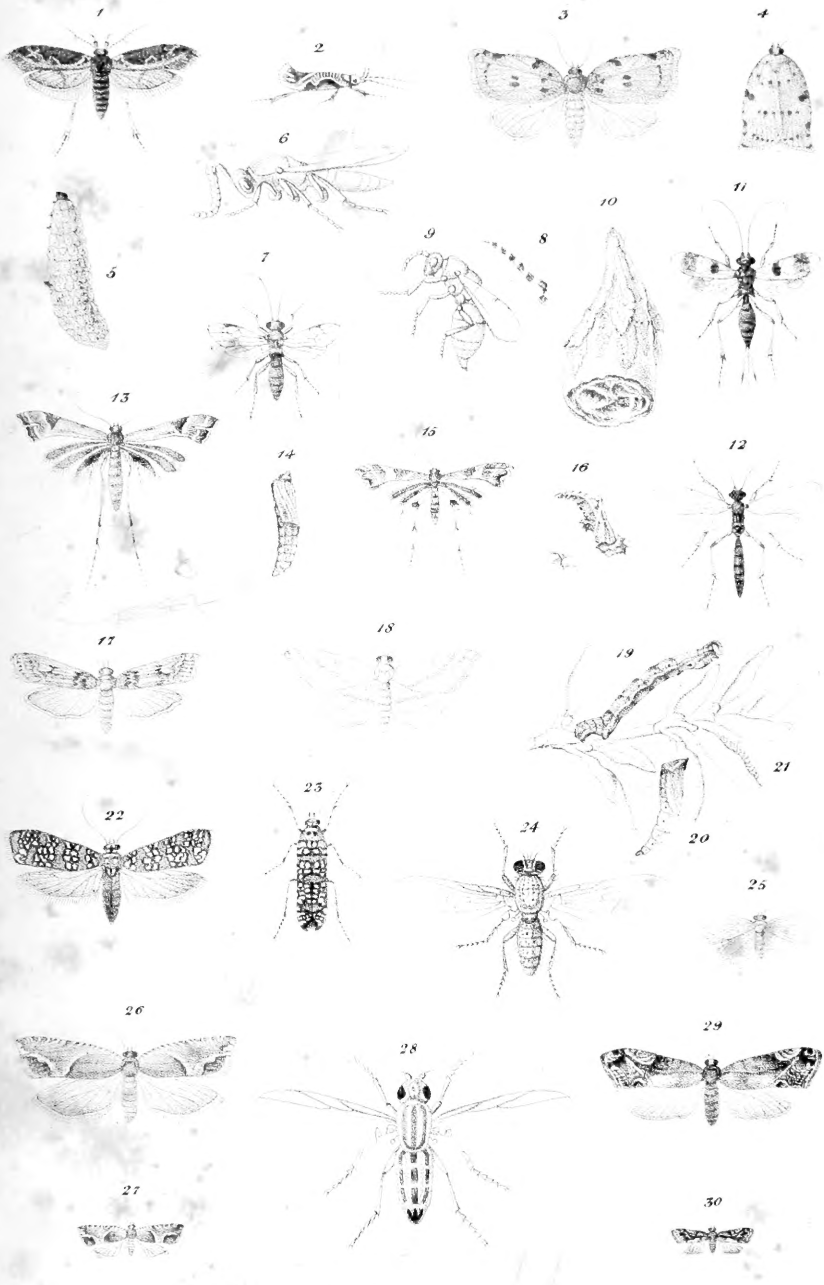

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FIRST ANNUAL REPORT

ON THE

Noxious,

BENEFICIAL AND OTHER

INSECTS,

OF THE

STATE OF MISSOURI,

MADE TO THE STATE BOARD OF AGRICULTURE, PURSUANT TO AN APPROPRIATION FOR THIS PURPOSE FROM THE LEGISLATURE OF THE STATE.

BY CHARLES V. RILEY,
STATE ENTOMOLOGIST.

JEFFERSON CITY, MO.,
ELLWOOD KIRBY, PUBLIC PRINTER.
1869.

INTRODUCTORY.

To the Members of the Missouri State Board of Agriculture:

GENTLEMEN:—I herewith present my first annual report on the Noxious, Beneficial and other Insects of the State of Missouri, pursuant to your instructions of April 1st, 1868.

It is neither so full nor so valuable as I hope to make its successors, should the office be continued. This is principally owing to the fact, that but eight months have elapsed since my appointment, and that the natural history of a number of the insects that received my attention during the summer, can only be given after they have completed their transformations, which will require one, two and in some cases, even three years.

I have been exceedingly gratified at the warm reception which I have met with from all quarters. Wherever I have been, from one end of the State to the other, the cordial hand has been extended, and I have found our farmers and fruit-growers thoroughly alive to the importance of the work, for they know full well that they must fight intelligently, their tiny but mighty insect foes, if they wish reward for their labors. During the year 1868, insects injurious to our fruits have been unusually numerous, but it may well be asked whether this increase is not a meteorological effect, as was suggested by Mr. W. C. Flagg, in his *ad interim* report to the Illinois State Horticultural Society, rather than one caused by the increase of our products. The severe drouth of 1867, had a peculiarly injurious effect on many trees, and it seems quite evident that certain insects increase more rapidly in injured fruits and injured trees than in those which are healthy and vigorous. The part, indeed, which insects principally have to play in the economy of this world, is that of scavengers. They hasten the decay and dissolution of unhealthy vegetable organism, the quicker to convert it into mould, and make room for healthy plants; while they multiply at such a prodigious rate, that whenever the conditions are at all favorable to the increase of a particular species, that species appears as if by magic, over vast districts of country, and commits sad havoc to either orchard or field crops, as the case may be.

With this view of the matter, we might materially check the increase of some insects, by anticipating Nature in her operations, and

cutting down such trees as have been injured from whatsoever cause, so that they shall not remain from year to year as a hiding place for noxious insects, or as a hot-bed for equally injurious funguses.

The peach crop failed pretty generally on account of the great increase of the Plum Curculio, and the opinion has been advanced and extensively published, that this insect will cause a failure of that crop in certain districts for very many years to come. Let the wise place no confidence in such predictions, for the predictors can have but a vague conception of the grand scheme of Nature, and of the laws which govern both animal and vegetable life. For many reasons unnecessary to mention, the prospect for a good crop the year succeeding an entire failure, is greater than at any other period—at least so far as insects are concerned. Because an insect is numerous and destructive one year, therefore it will be even more so the next, is apparently plausible but very fallacious reasoning. Every one of the thousands of species which are known to exist, multiplies at a sufficient rate to entirely cover our globe, in a comparatively short time, if nothing hindered; and the struggle and warfare necessary to enable all the different species to exist and hold their own, causes a constant fluctuation in the relative proportion of each. We have an illustration of this in the case of the Colorado Potato Beetle; for in those districts where it had caused so much alarm in 1866 and 1867, its enemies have so increased that it was comparatively harmless in 1868.

The importance of the study of Entomology has already become apparent to every tiller of the soil, but there is yet a class of citizens who fail to appreciate the laborious efforts of an Entomologist, and cannot conceive how the "study of bugs," as they term it, will redound to the good of a State or community. For the benefit of such, let me say, that in his last annual address the president of our State Horticultural Society, estimated the annual loss to our State from insect depredations at SIXTY MILLION DOLLARS! Now, allowing this estimate to be twice as great as the facts will warrant, the sum is yet quite enormous. It is not possible by any preventive measures to save the whole of this immense sum, but it is perfectly practicable to save a large percentage of it, and in this assertion I think the following pages will bear me out. A knowledge of the habits and transformations of insects frequently gives the clue to their easy eradication and destruction, and enables the agriculturist and horticulturist to *prevent* their ravages in the future. It likewise enables them to distinguish between their insect friends and insect enemies, and guards them against the impositions of the numerous quacks and nostrum-venders, who, with high-sounding words are constantly putting forth every energy to sell their vile compositions. Such a knowledge of insects the farmer has not time to acquire, for it is only obtained by an immense amount of hard labor in the field and

anxious deliberation in the closet. Hence, the wisdom of having a State officer who can devote his whole time to the work.

Fully aware that I write for those who, as a rule, are unversed in Entomology, I have endeavored to treat of each insect with as little of the nomenclature of science as is consistent with clearness of expression. Yet, as much that is of scientific interest, such as descriptions of new species, must necessarily be inserted, I have had such descriptions printed in a type of smaller size than the text, so that it can be skipped if desirable, at the time of reading, and easily referred to for comparison, with specimens which one is desirous of naming. I have also endeavored to illustrate, as far as possible, the insects of which this report treats, believing that good illustration forms the basis of successful teaching in a science with which the general husbandman is not expected to be acquainted; for the eye conveys to the mind, in an instant, what the ear would fail to do in an hour. The practical man cares little to what genus or family an insect belongs, so long as he can tell whether it be friend or foe. He must become familiarized with the insects about him without having necessarily to overcome scientific detail and technicality.

I have made no effort at a systematic arrangement of the insects treated of. Indeed, that were useless for the purpose in view; but in order that the reader may refer the more readily to any particular insect which interests him, I have separated them into three series—Noxious, Beneficial and Innoxious—and attached a very full index. For the benefit of those who are making a study of Entomology, I have also given, with each species, the order and family to which it belongs, in parenthesis under each heading.

So far as possible, I have used a common name for each insect, knowing that the scientific name is remembered with greater difficulty, and is, consequently, distasteful to many. But as popular names are very loosely applied, and the same name often refers to different insects in different localities, a great deal of confusion would ensue without the scientific name, which is, therefore, invariably added for the most part in parenthesis, so that it may be skipped without interfering in any way with the sense of the text.

The sign ♂ wherever used in this report, is an abbreviation for the word male, the sign ♀ for female and the sign ☿ for neuter.

Wherever the illustrations are enlarged, they are accompanied by hair-lines, which designate their natural size.

Where the measurement of an insect is given, the dimensions are expressed in inches and the fractional parts of an inch, 0.25, thus implying a quarter of an inch, and 1.25 one inch and a quarter, etc.

Many letters were addressed to me, during the summer, inquiring as to the value of the new carbolic acid, which has been so much spoken of. Having fully experimented with it during the summer, I am well pleased with it as an insect destroyer. But a word of warning in its use is necessary. It is also known by the name of cresylic

acid, the difference between the two being one of purity only. Many, having seen it recommended, ordered the crude acid, and, using it—no matter how much diluted—they found to their sorrow that it killed their plants. *Carbolic acid mixes well with alkalies, but not with water, and it can only be used as a saponaceous compound.* This fact must be borne in mind by those who wish to use it.

As I shall frequently have occasion to refer to the "AMERICAN ENTOMOLOGIST," it is but proper to say, that in conjunction with Mr. Benj. D. Walsh, State Entomologist of Illinois, I commenced last September, the publication of that journal. It is devoted to Economic Entomology, and is published monthly, by R. P. Studley & Co., of St. Louis, at $1,00 per annum. We felt that pending the issuing of our annual reports, something was needed, as a more frequent means of communication with the people. The paper has received the highest encomiums from the press throughout the country, and as an enterprise has proved successful beyond our expectations—evidence of the great demand for, and need of, the kind of information which it gives.

As there must necessarily be a limit to a report of this character, I am compelled to defer till another year, accounts of the Chinch Bug, Rocky Mountain Grasshopper, and some other insects which attracted general attention during the year, and do so the more willingly, that their habits have been pretty fully given in former publications, and in the above periodical.

In conclusion, I tender my sincere thanks to those gentlemen, throughout the country, who have assisted me in one way or another, and especially to the Superintendents of the Pacific, Iron Mountain, Hannibal & St. Joseph, and North Missouri Railroads, for free passes over their respective routes.

Respectfully submitted,

CHARLES V. RILEY,
State Entomologist.

ST. LOUIS, MO., Dec. 2d, 1868.

NOXIOUS INSECTS.

THE BARK-LICE OF THE APPLE-TREE.

(Homoptera, Coccidæ.)

[Fig. 1.]

There are two species of Bark-lice that attack the Apple-tree in the United States, which I will briefly describe.

The first, which is a native North American insect, is now known as Harris's Bark-louse (*Aspidiotus Harrisii*, Walsh.) The color of the scale is dirty white, and its form is irregular, being usually egg-shaped; but, however variable in outline, it is always quite flat and causes the infested tree to wear the appearance of Figure 1; while the minute eggs which are found under it in winter time are invariably blood-red or lake-red. This species has scarcely ever been known to increase sufficiently to do material damage, for the reason doubtless that there have, hitherto, always been natural enemies and parasites enough to keep it in due bounds. Though I have not witnessed it in Missouri myself, I am informed by several persons that it occurs in the northern part of the State, and a communication from R. B. Palmer, of Hartville, Wright county, published in the *Rural World*, of October 15, 1866, and stating that the lice are destroying the best apple orchards in that neighborhood, evidently refers to this species.

The second species, which is known as the Oyster-shell Bark-louse (*Aspidiotus conchiformis*, Gmélin), is by no means so harmless however, for it is one of the most pernicious and destructive insects, which the apple-grower in the Northern States has to contend with. This species presents the appearance of Figure 2, and may always be distinguished from the former by having a very uniform muscle-shaped scale of an ash-gray color (the identical color of the bark), and by these scales containing, in the winter time, not red, but pure white colored eggs.

There is scarcely an apple-orchard in Northern Illinois, in Iowa or in Wisconsin, that has not suffered more or less from its attacks,

[Fig. 2.]

and many an one has been slowly but surely bled to death by this tiny sap-sucker. It was introduced into the Eastern States more than seventy years ago from Europe, and had already reached as far west as Wisconsin in 1840, from whence it spread at a most alarming rate, throughout the districts bordering on Lake Michigan. It occurs at the present time in Minnesota and Iowa, but whether or not it extends westward beyond the Missouri river, there are no data to show. Its extension southward is undoubtedly limited, for though so abundant in the northern half of Illinois, observation has clearly proved that it cannot exist in the southern half of the same State. I have also experimentally proved that it cannot exist in the latitude of St. Louis, the experiment being made in the following manner: On the 12th of May last, I received some scales from Jesse Hodgson, of Panola, in Woodford county, Illinois, the eggs under which were at that time hatching. Upon fastening the bark containing these scales to the twigs of a living apple-tree, that being in a position where I could easily watch them, the young bark-lice crawled actively over these living twigs, and soon fastened themselves, as is their wont, around the buds. They soon began to secrete the waxy fibres, shown at Figure 3, 3, and in time assumed the white appearance of the first scale, which has been very aptly termed the *larval* scale by Mr. Walsh. But the growth at this point was arrested and they all soon afterwards died. As there were three twigs thickly covered, and as I could discover no parasites or cannibals of any kind, it is to my mind conclusive that THIS BARK-LOUSE CANNOT EXIST FURTHER SOUTH IN MISSOURI THAN ST. LOUIS. The experience of others is to the same effect, for Dr. Morse informs me that certain apple trees which he procured from the North, and which he planted at Kirkwood, St. Louis county, some years ago, though covered at that time with these bark-lice, are now entirely free of them; and Mr. Wm. Muir, of Fox Creek, in the same county, has had a similar experience with trees which he imported several years ago from Burrell & Co., of Lockport, N. Y., and which at the time of their receipt were very badly infested.

The fruit-growers of Southern Missouri, have therefore little to fear from this Oyster-shell Bark-louse, and it is not unlikely that it would die out in the country considerably north of St. Louis, if imported there; but, as it exists and flourishes near the southern border of Iowa, and extends, in Illinois, below our northern boundary, there is every reason to believe that it will flourish in the extreme northern counties of our State if once introduced there. Now, up to the present time, it has not made its appearance, as far as I can learn, in any of the orchards in that part of Missouri, and it seems that, as a State, we are entirely exempt from this most grievous orchard pest. In or-

der to definitely decide this matter I took particular pains, while at Hannibal during the summer, to inquire of the old fruit men there on this point, and even John Fry, one of the oldest settlers, has never heard of its appearance in that vicinity. The responses from numerous letters that were sent, with the same query, to men living in other northern parts of the State, are to the same effect. Believing therefore, that this insect *can* flourish in our extreme northern counties if once introduced there, and that at present the fruit-growers of that region are exempt from it, I cannot too strongly urge them to hold the vantage ground they now have. *Let every man therefore who reads this report, and who contemplates planting an apple orchard in North Missouri, in duty to himself and to his neighbors, subject every young tree which he receives from northern or eastern nurseries, to a rigorous inspection; and if any be found infested, let them be thoroughly cleansed before planting. By this means alone, can we hope to retain that immunity, which we have so far enjoyed!*

It should indeed be a maxim with fruit growers to inspect all young trees received from a distance; for many of our very worst insect foes, such as the Canker-worm, Root-louse, etc., are undoubtedly transported from one place to another, principally on nursery stock. In order that the Oyster-shell Bark-louse may be at once recognized and thoroughly understood, I will proceed with its history:

During the summer of 1867, three independent observers were closely studying the habits of this insect in Northern Illinois, unbeknown to each other, namely: Dr. H. Shimer, at Mount Carroll; Benj. D. Walsh, at Rock Island, and myself, at Chicago. Up to this time, though it had frequently been treated of, yet much that was recorded of its history was mere conjecture. For instance, Harris states that there are two broods each year, while Fitch assures us that the scales are the bodies of the gravid females, covering and protecting their eggs; neither of which is the case.

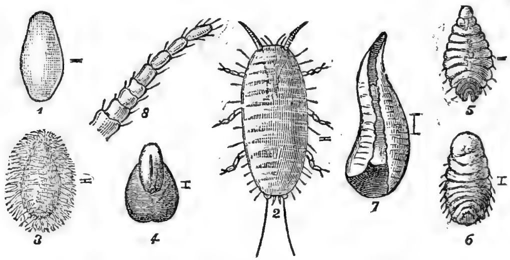
The gist of Dr. Shimer's observations which were recorded in a paper published in the Transactions of the American Entomological Society, (Vol. 1, No. 4) are, 1st—that he discovered that the tarsal joint of the newly hatched larva, which is very small, possesses no claw, but is furnished at the extremity with four fleshy hair-like processes upon which the young louse walks, and which he calls *digituli;* 2d—that the scale is constructed by the insect, and consists of the moulted skins of the louse, soldered together by some secretion which he believes to be the excrement. In these characteristics, he finds sufficient grounds for separating this insect from the Bark-louse family (COCCIDÆ) to which it has been referred by Linnæus, Gœffroy, Fabricius, Burmeister, Reaumur, Curtis, Westwood, and many other authors, and erects a new family (LEPIDOSAPHIDÆ), and a new genus (*Lepidosaphes*), to contain it. He furthermore takes it upon himself to deny what all these authors have insisted upon, viz:—that the loss of members, or the change from the perfect and active larval form

represented at Figure 3, 3, to the motionless and memberless forms shown at 5 and 6 of the same figure, is an evidence of the degeneration or degradation in this insect as it approaches the imago state.

Mr. Walsh, whose observations are recorded in his First Annual Report, as Acting State Entomologist of Illinois, found nothing to induce him to separate this insect from the old genus *Aspidiotus* in the Bark-louse family, to which it had hitherto been referred. He also showed that there were three distinct growths of the scale, differing from each other in size and color, which he named respectively the "*larval scale*," "*medial scale*" and "*anal sack*." He also inclined to believe that both the "medial scale" and "anal sack" were formed "by the anal surface of the original young larva being at two successive periods abnormally dilated and extended backwards, in the form of a sack closed at tip; and that, after this process is accomplished, the insect always moults or sloughs off the whole of the external scale." As to the formation of the "larval scale" he offers no explanation.

My own observations will be found in the "Report of the Committee on Entomology," published in the Transactions of the Illinois State Horticultural Society for 1867—pp. 109–112. Having had no opportunity of continuing them the past summer, and as they will convey a good idea of this insect's mode of growth, I repeat them in part.

[Fig. 3*.]



The young lice usually leave the scales during the first week in June. Prior to their hatching, the eggs which were previously snow-white, become yellowish, and if the weather turn cool, immediately after hatching, they will remain for two or three days under the scales before dispersing over the tree. The following notes as before stated, were made in Cook County, Illinois.

June 6th.—Most of the eggs are hatched, but the young have not yet left the scales.

*These figures are highly magnified, the hair lines at their sides approximating the natural lengths. 1, egg—natural size scarcely .01. 2, larva, as it appears when running over the twigs—natural length .01. 3, its appearance soon after becoming fixed. 4, appearance of scale after the second plate is formed. 5, form of louse (ventral view) soon after losing its members. 6, form of louse (ventral view) when full grown and just about to deposit. 7, fully formed scale, containing louse, as it appears from the underside, when raised. 8, highly magnified antenna of larva, showing joints.

June 9th.—The past two days have been exceedingly warm, the thermometer rising above 90 degrees F. in the shade, and the young lice are running all over the twigs.

June 11th.—They have all become fixed, having gathered in the greatest numbers around the base of the lateral shoots of the terminal twigs.

June 12th.—A white, waxy secretion commences to issue from the body, in the shape of very fine, delicate threads (see Fig. 3, 3).

June 22d.—They have increased materially in size, the waxy secretion vanishing soon after the last date, leaving what appears to be the body, of a yellowish brown color, though in reality the body is underneath and separate, and has lost all trace of members.

July 1st.—Though watched every day, there is no perceptible change since the 22d of June.

July 2d.—They are now 0.03 long, or three times as large as when hatched, and a thin, waxy secretion commences to appear at the posterior end.

July 6th.—This secretion has increased rapidly, and taken on a somewhat oval form, with usually a slight cut or depression posteriorly. It appears quite distinct from the original yellowish-brown portion, and is duller, or of a more grayish color. On raising it carefully, the louse is seen underneath, yellowish, of a flattened form, the anterior tapering more than the posterior portion, which latter is always distinguished by having a patch of bright reddish-brown (see Fig. 3, 5). Though from analogy it must have a beak of some kind, it is so exceedingly fine and fragile that I have never been able perceive it.

July 10th.—There seems to be another pause in the growth, the scale presenting the appearance of Figure 3, 4.

July 12th.—A third plate or secretion has commenced from the posterior portion.

July 15th.—This last plate enlarges rapidly, and is the exact color of the bark.

July 20th.—The three plates are at present readily distinguished; the last, which is considerably larger than the two others together, having usually taken a slight curve, which gives the scale its characteristic form.

August 1st.—Their growth is to all appearances completed, the scale measuring 0.12, while the louse measure but 0.05, occupying thus about half the space within. The three different growths are now not readily distinguished, though the narrow end is always reddish-brown. On lifting the scale the insect does not fall out, being retained by a slight whitish fringe extending from each side of the scale (see Fig. 3, 7).

August 12th.—Some of them have commenced to deposit eggs.

August 28th.—The eggs are now, apparently, all deposited, and I have watched with interest, as the deposition went on, the body of the parent louse shrinking day by day, instead of extending and becoming

gravid, until it is now a mere atom at the anterior or narrow end of the scale, in a few days scarcely to be noticed at all.

The oyster-shell bark-louse produces but one brood annually, and these eggs, therefore, remain under the scales for more than nine months of the year, subjected alike to the continuous warmth of the fall months, and to the severe frosts of winter; freezing and thawing again and again, without their vitality being in the least impaired. In order to show the conclusions which I came to, after the above observations, I will, in a measure repeat them.

All writers on this Bark-louse, copying after Fitch and others, tell you that the scale you see on your trees is the gravid body of the female insect. Now, though for aught I know the body proper of the female may, in some Coccidan species, extend and cover the eggs she deposits, it is no such thing in this instance; and I am prepared to affirm that the scale is no more the insect's gravid body than is the empty muscle shell the distended outer membrane of the muscle, or the oyster shell that of the oyster.

How this scale is formed I do not profess to have discovered. With regard to our native white species, already referred to (p. 7), Mr. Walsh, in the Practical Entomologist for December last, refutes Harris's theory, namely, that it is formed in the same way as the down which exudes from other lice, and shows, with some plausibility, that it may consist of the cast-off skins of the insect. Now, in my own humble opinion, with the imported species under consideration, I am inclined to uphold Harris, for the following reasons: besides the fine waxy filaments which it secretes when becoming fixed, I have found that, even before these are thrown out, it is covered with a fine, white bloom, proving that it can and does secrete from the general surface; having carefully lifted the scale, every day during the growth of the third portion referred to, the louse has invariably been found in the same shape and condition, without apparent connection with it, while the scale, to all appearances, actually increases in bulk during the time the eggs are being deposited. Furthermore, the exuviæ of such a tiny insect would be infinitely thinner and more delicate than is the scale, and as the insections, especially of the verter, are always plainly visible with a glass, in the louse, we should expect to see them in the scale, which is, however, perfectly smooth. Again, the louse is of the same color throughout its growth, while at one time the three parts of the scale are perceptibly different in this respect. Moreover, Reaumur long ago (Memoires, tom. IV., p. 26) observed a species occurring on the peach in France to cast its skin in flakes, much in the manner as many of our *Dipterous* and *Hymenopterous* larvæ are known to do; while he also described a species (pp. 64, 65, ibid.) occuring on the vine, which covered its eggs with a white, gummy, cottony secretion; and Mr. Walsh himself, in the February number of the little monthly already referred to, p. 57, speaking of a species occurring on the under surface of the leaves of the *Olea*

fragrans, shows how in that species the "scale" is not formed of the lifeless body of the female, but is a distinct integument, constructed by the female to protect herself and her eggs, and probably *secreted from the general surface of the body.*

However, I believe that the entomologist will have about as difficult a task to ascertain its real mode of growth as would the physiologist to learn how the flesh on your fingers acquires its natural form. We might with equal reason try to learn why and how the thousand different excrescences and galls caused by insects are formed! Why is it that the larva hatching from an egg deposited on a rose leaf by a little four-winged fly, the *Rhodites ignota* of Osten Sacken, causes a peculiar growth or gall in the form of a mangel-wurzel, or beet seed, to surround it, while that of a similar fly, belonging to the very same genus—the *Rhodites radicum* of Osten Sacken—hatched from eggs deposited in the root of the same plant, causes an entirely different gall? Why is it that the puncture of a little yellow louse, *Pemphigus (?) vitifoliæ*, Fitch (or as Henry Shimer, of Mt. Carroll, would have it, *Daktylosphæra vitifoliæ*), by puncturing a grape leaf, causes an unnatural growth to surround and entomb it in the shape of the little green globular galls of different sizes, so common on Clinton grape vines, while the same sized puncture of another louse (*Aphis vitis*, Scopoli) produces no such effect? Why, again, does a little Lepidopterous larva, often found in the golden rod (the larva of *Gelechia gallæsolidaginis*, described in a future chapter of this report), produce an elongated hollow gall, while a Dipterous larva (*Trypeta solidaginis*, Fitch), in a neighboring stalk produces one that is round and solid? Or, lastly, why should the suction of different species of Dipterous larvæ (*Cecidomyiæ*), produce the wonderful galls found on our willows, causing in many instances not only a total change in the texture of the leaf, but also in its mode of growth?

To me the formation of our Bark-louse scale appears somewhat analagous to all of these, and a thousand other such phenomena known to science; and in answering how such growths, peculiar to each species, are formed, or why each is so constant in its character, I can only say that it is their nature; or, with Devere, "that knowledge of first causes belongs to Him alone, who allows the eye of man to see final causes only." The more we endeavor to study the why and the wherefore of these things the more the mind is filled with the idea of Infinity, and escaping from all visible impressions of space and time rises to sublimest contemplation of the Creator.

The growth of the scale under consideration, to my mind, depends no more on the will of the louse underneath it than does the sponge on that of the slimy, jelly-like creature which secretes it, or the coral on that of its polype; or, to use a more patent illustration, than the growth of our bones, though secreted from our organs, depends on our will.

By carefully lifting one of these scales during the months of July

and August, any of you may find the true louse underneath, occupying but a portion of, and being quite separate from it.

From analogy we may presume that there are males as well as females of this species, since winged males are known to occur in the genus *Aspidiotus*, and it has been my great aim and hope to discover this gentleman. Though an extremely small percentage of the scales may generally be found dwarfed and empty during the first days of August, suggesting that a male may have escaped, yet as likely as not these may have been killed by some cause or other. In the latter part of June I counted five hundred scales on a single twig, and marked them to prevent mistake or confusion in recognizing them again. After watching them steadily, and carefully lifting each one on the 28th of August, they all, with the exception of two, were found to contain eggs. The same average would doubtless have been found over the whole tree; and from this fact I am constrained to believe that as a rule no males appear, and that if there be exceptions where they do occur, they are in such proportion as to be of little avail. Mr. Shimer, in speaking of the Clinton grape gall, already alluded to, states that he opened thousands of them before he found a male; and it is difficult to conceive what effect a single delicate male, shut up in a gall, could have on the thousands of others not dignified by his presence. When we reflect on the abnormities occurring among our plant-lice, I see no reason why our bark-lice should not be hermaphrodite as a rule, and yet occasionally produce males. They are still lower in the scale of Nature than the plant-lice, and one of them—the celebrated Cochineal—puzzled naturalists a long time as to whether it was a plant or an animal. There is in fact so much of the anomalous about this family that it furnishes a rich and interesting field of study.

The observations of both, Mr. Shimer, Mr. Walsh, and myself agreed as to the time of hatching; as to the mode of growth of the scale, and as to finding no females; but as to the process by which the scale was formed there was difference of opinion. The reason, it seems to me, is obvious enough: in attempting to elucidate the problem we reach beyond the limits of our power of perception into the realms of conjecture. It is easy enough to watch the mode of growth of an oak-apple, but it is not such an easy matter to ascertain the reason why the kind which occurs on the red oak (produced by *Cynips quercus-inanis*) should form inside with radiating spokes from a common central cell; while that on the black oak (produced by *Cynips*? *quercus-spongifica*) should form inside with a dense spongy substance around a similar central cell. Mr. Shimer may, in part, be right in stating that the larval scale is formed by the young louse shedding its skin; but the extremely fine skin alone would not form such a scale, and he strangely overlooks the wax-like filaments secreted from the general surface of the body as well as the peculiar distinction in the growth of the "medial" and "anal" sacks. That these

two last scales are *constructed* by the louse, of its own cast skins and some excrementitious secretion, as he suggests, is also made *extremely* doubtful, from the simple fact that you may raise them every day of their growth and find the louse underneath, entirely free and separate. But after all, though of great scientific interest this matter is of no practical importance whatever, for as we shall see hereafter the great point to be borne in mind, in a practical light, is the time of hatching of the egg.

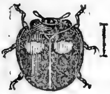
As the female Bark-louse is only capable of motion for a period of from two to three days at the most, after which time she becomes as permanently fixed for the rest of her life as is the tree on which she is fastened; and as the winged males (even if they ever exist) could not assist in the spread of the species, it may puzzle some to divine how this insect spreads from tree to tree and place to place. That it is transported to distant places, mainly on young trees, there can be no doubt, and there are various ways in which it can spread from tree to tree in the same orchard, though it can only thus spread during the few days of its active larval state. Mr. Walsh believes that the only way, as a general rule, that it can spread from tree to tree, when the boughs of those trees do not absolutely interlock, is by a few of these active young larvæ, crawling accidentally on to the legs of some bird, that chances to light on one tree and afterwards flies to another, and he even goes so far as to say that he believes this Bark-louse would soon cease to exist, if all the birds in the world were killed off (Rep. p. 41). My friend Walsh seems to have a special grudge against the birds, and it is hard to imagine how he could make such a statement, in face of the fact that where there is one bird, there are a hundred insects roaming constantly from tree to tree, that are just as capable of giving the young lice a lift. Moreover the specific gravity of the young louse is so slight that it almost floats in the air, and is undoubtedly aided in spreading by the winds; while on a tree very thickly covered with old scales, its traveling propensities are sufficiently developed to cause it to run down the trunk of the tree and *even over the ground*, and as it travels at the rate of two or three inches per minute, it could manage to measure several rods with its microscopic legs, in the course of its active state.

Though essentially belonging to the apple tree, this Muscle-shaped bark-louse is not unfrequently found both upon the Currant, the Plum and the Pear. I have seen the scales fully developed and bearing healthy eggs *on the fruit* of the White Doyenne pear, of the Transcendent crab, and of the wild plum (*Prunus Americana*) which have been sent to me by Mr. T. D. Plumb, of the State Journal, Madison, Wisconsin; and, though on the hard bark of a tree, we cannot judge of the amount of sap they absorb, it is quite apparent on these soft fruits, for each scale causes a considerable depression from the general surface. I have also received twigs of the Persian lilac from

F. Starr, of Alton, Illinois, covered with a species, which, if not the same, is exceedingly like it.

Natural Remedies.—It was last year simultaneously discovered by Mr. Walsh and Mr. Shimer, that a species of mite (*Acarus* family) preyed unmercifully on the louse as well as on its eggs. This mite was described by Mr. Shimer as *Acarus malus* in the paper already referred to, and it appears that it greatly resembles the young bark-lice. Mites are not true insects, but belong to the same class (*Arachnida*) to which our spiders belong, and although the species are numerous—some causing galls on plants, some living externally on vegetable substances and seeds, either in a sound or rotten condition, others devouring animal substances, both dead and living, while others again are parasitic on certain animals—yet they all are readily distinguished in the perfect state from true insects by having four pairs of legs, and by the head and thorax being soldered in one piece without any joint whatever. Some of them, in the larval state, have but six legs, thus still more closely mimicking the young bark-lice, but they all acquire eight in the full grown state. This mite, so insignificant that in the larval state it can only be noticed by careful watching with a pocket-lens, has, doubtless, done more to save the apple trees in the Northern States than any one thing else; and its existence explains the gradual decrease of the Bark-louse that is known to have occurred in many orchards, and also accounts for its entire extermination on certain trees.

Fig. 4.



The next most efficient aid we have is the Twice-stabbed lady-bird (*Chilocorus bivulnerus*, Muls.) This good friend is readily recognized by its polished black color, and the blood-red spot on each wing-case. It is represented magnified at Figure 4, the hair line at the side showing the natural length. Its larva (Fig. 5) is a dark gray prickly affair, and is extremely active and voracious. In changing to pupa, the larval skin splits open on the back, but the naked pupa, which is of the color of burnt-umber with lighter sides, remains within it as if for protection. In this latter state these lady-birds may often be found fastened in clusters of from six to twenty on apple trees affected with either kind of bark-louse, and they should invariably be protected. It is astonishing how rapidly they will cleanse a tree from its vermin, and there is no better way of getting rid of bark-lice than by introducing a few of these little friends onto the lousy tree.

Fig. 5.

Artificial Remedies.—These may be summed up in a very few words, and consist, for the most part, in prevention, and I again urge a strict examination of every young tree before it is planted. If an orchard is once attacked before its owner is aware of it, much could be done on young tress by scraping the scales off in winter, but on large trees where it is difficult to reach all the terminal twigs, this method becomes altogether impracticable, and it will avail but little

to cleanse the trunk alone, as most of the scales containing living eggs will be found on the terminal branches. Alkaline washes, and all other washes, except those of an oily nature, such as petroleum or kerosene, are of no avail when applied to the scales, for the simple reason that they do not penetrate and reach the eggs which are so well protected by these scales; and it is very doubtful whether any solution can be used that is sufficiently oily to penetrate the scales and kill the eggs without injuring the tree, especially while the sap of the tree is inactive. Hence, this Bark-louse can only be successfully fought at the time the eggs are hatching, and the young lice are crawling over the limbs. The time of year in which this occurs has already been indicated, and the trees should be closely watched during the last days of May and the first days of June, for, without close scrutiny, they will not be observed, appearing simply like very minute, white, moving specks. While the young larvæ are thus crawling over the tree, they are so tender that they can be readily destroyed by simply scrubbing the limbs with a stiff brush. It it quite evident, however, that any remedy, to become practicable on a large scale, so as to rapidly and effectually reach every limb of the tree, both large and small, must be applied by a syringe or by means of fumigation, and that whatever be applied, it must kill the lice without injuring the foliage or fruit, as the young apples are generally as large as a good sized pea by the time the lice hatch. Fumigation has not yet been sufficiently tried to enable us to judge of its merits. A correspondent of the *Prairie Farmer*, in recommending brimstone, gives the following as his plan of using it: " My plan is to cover the entire tree with cloth, so that there are no holes to let out the smoke; take an iron dish—a frying pan with a handle, if you please—put in about one pound of roll brimstone (not sulphur), heat a chunk of iron red hot—say a clock weight; drop the iron upon the brimstone, and put it under the tent cloth, where it should remain long enough to fairly smudge the whole tree. More brimstone can be added, and the iron repeated as often as desired, probably five minutes to a tree would be sufficient, more would do no harm. The cloth can be easily taken off and put on by two operators, each with a light pole with a spike in the end. The one pound of brimstone will burn about an hour." Having had no bark lice on which to try the above experiment, I wrote to the party recommending it, and as I received no answer, the experiment probably failed or was never tried. The brimstone would doubtless injure the tree.

Mr. A. R. Whitney, of Franklin Grove, Lee county, Illinois, whose apple trees have been troubled more or less with bark lice, found that an application of sheep manure around the trees, had a beneficial effect in checking the pests, and he attributes the result to the ammonia arising from the manure. With regard to washes, to be used with a syringe, the late Dr. Jno. A. Kennicott used 1 lb. of sal soda to one gallon of water with good effect; it is best used by heating o

redness in an iron pot and then dissolving it in the water. Mr. E. G. Mygatt, of Richmond, McHenry county, Illinois, has experimented with this insect for over 20 years with the following result: Brine (2 quarts salt to 8 of water) kills the lice, but also the foliage and fruit. Tobacco water (strong decoction) neither injures the foliage nor affects the lice. A solution of cobalt kills the lice, but takes the foliage also. Weak lye kills the lice, but also somewhat affects the leaves. Lime water kills about half the lice, and affects the leaves a little. Finally, quassia, boiled in proportion of 1 pound to 3 gallons of water, though well known to be effectual for the common plant-lice, has no effect on these coccids. In short, we have abundant proof that neither tobacco-water nor strong alkaline washes have any effect on these young lice, though a strong solution of soap *will* kill them, and my experience the past season, with cresylic acid soap in other directions, leads me to strongly recommend it for this purpose. It will sometimes be necessary to repeat the wash, as the lice do not all hatch out the same day, though the period of hatching seldom extends over three days.

From the foregoing it is obvious that bark-lice can only be successfully fought during three or four days of the year: how absurd and ridiculous then, are all the patent nostrums and compounds which are continuously offered to the public as perfect "bark-lice extinguishers," and which never mention this most important fact. May this insight into the history of the Apple tree Bark lice, prevent many a man from being swindled out of his time and money by these impostors!

THE PERIODICAL CICADA.

(Homoptera Cicadidæ.)

SEVENTEEN AND THIRTEEN YEAR BROODS.

The year 1868 will long be remembered in the annals of insect life, as one of peculiar interest, from the fact that this singular Cicada (*Cicada septemdecim*, Linn.) popularly known as the "17-year locust," made its appearance very generally over the United States.

The metamorphoses of insects, their instructive industry, their quarrels and their instincts, afford abundant food for our love of the marvelous; but few of them can claim such a singular history as can our Periodical Cicada. We are moved to admiration in contemplating the fact that an insect, after living for 17 long years in the bowels of the earth, should at last change its sluggish, creeping and worm-like form, and, endowed with the power of flight, ascend from its earthy retreat to become a denizen of the air and to enjoy the full glory of the Sun. But our wonder increases when we reflect that this

same insect has appeared in some part or other of the United States at regular intervals of 17 years, for centuries, aye! for ages in the past. Long ere Columbus trod on American soil this lowly insect must have appeared regularly at its appointed time. It must have filled the woods with its rattling song, when none but wild beasts and savages were present to hear it. To me there is something beautiful in the idea that through its periodicity we are enabled with tolerable certainty to go back in thought, for centuries in the past, to a particular month of a particular year, when the woods resounded with its song in the same manner as they did last summer; for so regularly do the different broods appear, that one is perfectly warranted in the assumption, that in the month of June, in the year 1738, for instance, 130 years ago—they appeared in the southern part of Missouri, and that 6 years previously they had appeared in the northwestern corner of the same State.

Though so much had hitherto been written about this Cicada, yet some of the most interesting facts with regard to it were unknown till the past season. A very complete article on the subject was published in the December number of the AMERICAN ENTOMOLOGIST, which I shall for the most part repeat, and render more complete by the addition of some facts as to their distribution, which were contained in some unpublished manuscript of the late Dr. Gideon B. Smith, of Baltimore, Md., and which were comunnicated to me through the kindness of Dr. J. G. Morris of the same city.

It was my good fortune to discover that besides the 17-year broods, the appearance of one of which was recorded as long ago as 1633, there are also 13-year broods;* and that, though both sometimes occur in the same States, yet, in general terms, the 17-year broods may be said to belong to the Northern, and the 13-year broods to the Southern States, the dividing line being about latitude 38°, though in some places the 17-year brood extends below this line, while in Illinois the 13-year brood runs up considerably beyond it. It was also exceedingly gratifying to find, four months after I had published this fact, that the same discovery had been made years before by Dr. Smith, though it had never been given to the world.

It so happened that one of the largest 17-year broods, together with one of the largest 13-year broods, appeared simultaneously in the summer of 1868. Such an event, so far as regards these two particular broods, has not taken place since the year 1647, nor will it take place again till the year 2089.

There are absolutely no perceptible specific differences between the 17-year and the 13-year broods, other than in the time of maturing; but whether or not, scientifically speaking, they are to be considered as specifically distinct, the 13-year brood may, for convenience sake, be called *Cicada tredecim*, in contradistinction to *Cicada septemdecim*,

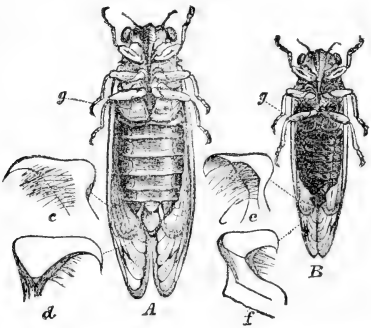
* See *Journal of Agriculture*, St. Louis, June 13, 1868, in which appeared the first account ever published of such a brood.

the 17 year brood. Mr. Walsh informs me that Charles Darwin, Prof. Asa Gray, and Dr. Hooker all agree in the belief that the 17-year and the 13-year forms ought not to be ranked as distinct species, unless other differences besides the period of development could be discovered, the mere rarity of variability in such a point not being sufficient.

TWO DISTINCT FORMS.

It is not a little singular, also, that two distinct forms occur in both broods—a large one and a small one—the former by far more numerous than the latter. This fact has been observed in past years, and was noticed the present year by independent observers in different parts of the country.† Indeed, it was observed by Dr. Hildreth, of Marietta, Ohio, as far back as 1830 (vide Silliman's Journal XVIII, p. 47). The true *Cicada septemdecim* of Linnæus (Fig. 6 *A*, ventral view of male), as described by Harris and Fitch, occurs in the greatest numbers, both in the 17 and 13-year broods. It will measure, on an average, one and a half inches from the head to tip of the closed wings, and almost always expands over three inches. The whole under side of the abdomen is of a dull orange-brown color, and in

[Fig 6.]



the male more especially, four or five of the segments are edged with the same color on the back.

The other form (Fig. 6 *B*, ventral view of male) is not, on an average, much more than two-thirds as large, and usually lacks entirely the dull orange abdominal marks, though there is sometimes a faint trace of them on the edges of the segments beneath. This small form was described in 1851, by Dr. J. C. Fisher, in the Proceedings of the "Philadelphia Academy of Natural Sciences," Vol. V, pp. 272-3, as a new species of

† 1. Mr. V. T. Chambers, in the August number of the "American Naturalist," p. 332, is said to point out some variation in color from those described by Dr. Fitch.

2. Mr. S. S. Rathvon favored me with specimens of both species from Lancaster county, Pa., accompanied with the following: "I am justified, I think, in concluding these are two distinct species. They are different in size and coloration, produce entirely different stridulation, do not cohabit indiscriminately," etc.

3. The correspondent to the Department of Agriculture (July Rep.) from Hematite, Mo., says: "There are two species, one (both male and female) about twice the size of the other, and differing greatly, also, in their cries and actions."

Cicada, hitherto confounded with *septemdecim*, and was named *Cicada cassinii.* His description was followed by a note from Mr. John Cassin, in which he states that the two forms show no disposition to associate together, and produce very different cries. The fact of the very great difference in the song of the males has been fully confirmed by the observations of M. C. Hill, of Northeast Ohio, who likewise found that the small form is very much less numerous than the large one.

The truest test of the specific distinction of these two forms lies in the comparative shape of the male genital hooks, and on submitting specimens of both forms to Dr. H. Hagen, of Cambridge, Mass., formerly of Köenigsburg, Prussia, he very kindly furnished the drawings *c*, *d*, *e*, and *f*, in Figure 6, which show the male genital hooks of both. That of *septemdecim* is represented on the outside at *c*, on the inside at *d*; and that of *cassinii* on the outside at *e*, and on the inside at *f*.

By these figures, it will be seen that there are sufficient differences to separate the two forms as distinct; but while the hooks of the large kind (*septemdecim*) are quite constant in their appearances those of the smaller kind (*cassinii*) are variable, and in some few specimens are undistinguishable from those of the large kind. This circumstance, coupled with the fact that the small kind regularly occurs with both the 17 and 13-year broods, would indicate it to be a dimorphous form of the larger, or true periodical species; especially when we consider that dimorphism and heteromorphism are not uncommon among the true Bugs (HEMIPTERA). Mr. P. R. Uhler, of Baltimore, Md., who has given this order of insects particular attention, informs me that he is not fully satisfied of the specific distinctness of *C. cassinii*; but Dr. Hagen thinks there is no possible doubt of its being distinct, for the simple reasons, as he states, that dimorphism occurs only in one sex, while here both sexes are involved; that *cassinii* appears later, makes a different noise, has different colors and was never seen to copulate with *septemdecim.* To use Dr. Hagen's own words, "what more is needed to make a distinct species; if one kind of Cicada requires 17 years to undergo its transformations, why not a second kind?" I find among a great number of specimen, which I have examined, that not only do the hooks of *cassinii* vary, but the other characters that have been mentioned as belonging to it, are variable, there being perfectly intermediate grades between its extreme type and that of *septemdecim.* Again, on the supposition that it is a distinct species, the chances are extremely small, of its issuing together with *septemdecim* in the *same* year in the many different localities hereafter mentioned. Therefore, though it will be convenient to use the two names, I think the two forms should not be ranked as distinct. But the discussion of the subject would involve the general problem of specific character.

The large species has been observed to make its appearance from eight to ten days earlier than the small species (*cassinii*), and there is not a single specimen of the latter, among a number of the 13-year

brood (*tredecim*) that I captured in May, though I took a few specimens afterwards.

THE SEASON OF THEIR APPEARANCE AND DISAPPEARANCE

differs somewhat with the latitude, though not so materially as one might suppose. According to the records, they appeared the past season earlier in the South than in the North; but the last half of May can be set down as the period during which they emerge from the ground, in any part of the country, while they generally leave by the 4th of July. In St. Louis county the past season they commenced issuing on the 22d of May, and by the 28th of the same month, the woods resounded with the rattling concourse of the perfect insect. As is the case with a great many other insects, the males make their appearance several days before the females, and also disappear sooner. Hence in the latter part of the Cicada season, though the woods are still full of females, the song of but very few males will be heard.

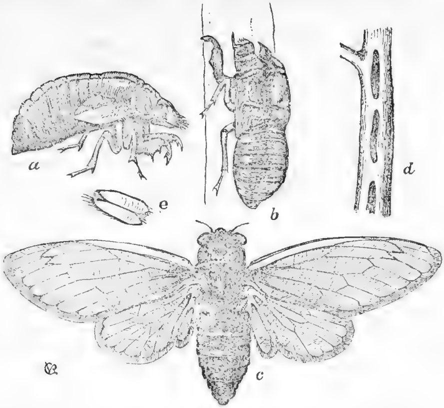
That circumstances favorable or otherwise may accelerate or retard their devolopment, was accidently proven, the past season, by Dr. E. S. Hull, of Alton, Illinois; as by constructing underground flues, for the purpose of forcing vegetables, he also caused the Cicadas to issue as early as the 20th of March, and at consecutive periods afterwards, till May, though strange to say these premature individuals did not sing. They frequently appear in small numbers, and more rarely in large numbers, the year before or the year after their proper period. This is more especially the case with the 13-year brood. Thus in Madison county in Illinois, and in Daviess and Clark counties in Missouri, there were in 1854 a few precursors to the true 1855 brood. They were also observed in Madison county, Illinois, in 1867; while "L. W." writing from Guntersville, Alabama, to the *Country Gentlemen* of June 25, 1868, says, "some call them 14-year locusts." Other such cases will be noticed hereafter.

THEIR NATURAL HISTORY AND TRANSFORMATIONS

have been sufficiently described in the standard works of both Harris and Fitch, and it is only necessary to mention a few facts not recorded by them.

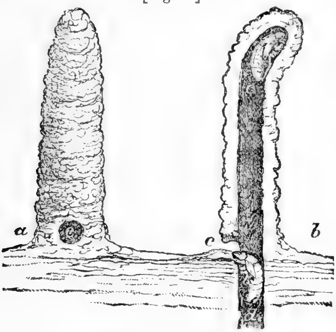
Mr. S. S. Rathvon, of Lancaster, Pa., who has himself witnessed four of their periodical visits, at intervals of 17 years, discovered the following very ingenious provision which the pupæ (Fig. 7, *a*) made the past season, in localities that were low or flat, and in which the drainage was imperfect. He says: "We had a series of heavy rains here about the time of their first appearance, and in such places and under such circumstances, the pupas would continue their galleries from four to six inches above ground (Fig. 8, *a* full view, *b* sectional

[Fig. 7.]



view), leaving an orifice of egress even with the surface (Fig. 8, *e*).—In the upper end of these chambers the pupas would be found awaiting their approaching time of change (Fig. 8, *c*). They would then back down to below the level of the earth, as at *d*, and issuing forth from the orifice, would attach themselves to the first object at hand and undergo their transformations in the usual manner." Mr. Rathvon kindly furnished me with one of these elevated chambers, from which the above drawings were taken. It measured about four inches in length, with a diameter on the inside of five-eighths of an inch, and on the outside of about one and a quarter inches. It was slightly bent at the top and sufficiently hard to carry through the mail without breaking.

[Fig. 8.]



The inside was roughened with the imprints of the spines with which the fore legs of the builder are armed. In a field that was being ploughed near St. Louis, about the time of their ascent, I found that single, straight or bent chambers were the most common, though there were sometimes several branching near the surface from a main chamber below, each of the branches containing a pupa. The same observations have been made by other parties. These holes are cylindrical and are evidently made by oppressing the earth on all sides and throwing the refuse to the bottom, which must be quite a feat when they penetrate hard roads or come up between two rocks as they frequently do.

The larvæ are frequently found at a great depth, nothwithstanding its denial. Thus Mr. Henry Sadorus of Port Byron, Illinois, who built a house in 1853, found that they came up through the bottom of his cellar in 1854, the cellar being over five feet deep, and Mr. F. Guy of Sulphur Springs informed me that he had found them at a depth of ten feet below the surface.

When ready to transform they invariably attach themselves to some object, and, after the fly has evolved, the pupa skin is left still adhering, as shown at Figure 7 *b*. The operation of emerging from the pupa most generally takes place between the hours of 6 and 9 P. M.; and ten minutes after the pupa skin bursts on the back the Cicada will have entirely freed itself from it. Immediately after leaving the pupa skin, the body is soft and white, with the exception of a black patch on the prothorax. The wings are developed in less than an hour, but the natural colors of the body are not acquired till several hours have elapsed. These recently developed Cicadas are somewhat dull for a day or so after transforming, but soon become more active, both in flight and song, as their muscles harden. For those who are not informed of the fact, I will state that the males alone are capable of "singing," and that they are true ventriloquists, their rattling noise being produced by a system of muscles in the lower part of the body, which work on the drums under the wings, shown in Figure 6, at *g g*, by alternately tightening and loosening them. The general noise, on approaching the infested woods, is a compromise between that of a distant threshing machine and a distant frog pond. That which they make when disturbed mimics a nest of young snakes or young birds under similar circumstances—a sort of scream. They can also produce a chirp somewhat like that of a cricket's, and a very loud shrill screech, prolonged for fifteen or twenty seconds, and gradually increasing in force and then decreasing.

After pairing, the females deposit their eggs in the twigs of different trees; and though for this purpose they seem to prefer the oaks and the hickories, they oviposit in almost every kind of deciduous tree, and even in herbaceous plants, and in evergreens. We have seen their eggs in the Chestnut, Locust, Willow and Cottonwood, in peach twigs of not more than $\frac{1}{8}$ inch diameter, and also in the stems of the common Eupatorium, while R. H. Warder, of Cleves, Ohio, has found them in the following evergreens: Thuja occidentalis, Juniperus virginiana and Abies canadensis, but was unable to find any traces of their work in either of our common pines—Pinus Austriaca, P. strobus or P. sylvestris.

Dr. Harris (*Inj. Ins.* p. 212) has well described the mode of depositing, and it is only necessary to add that the female always saws with her head upwards, *i. e.* towards the terminal part of the branch, except when she comes in contact with a side shoot, when, instead of

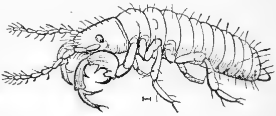
[Fig. 9.]

[Fig

shifting a little to one side, she reverses her position, and makes two punctures in an opposite direction to the rest, and thus fills up the straight row close to the base of the side shoot. The eggs (Fig. 7 *e*) are of a pearl white color, one-twelfth of an inch long, and taper to an obtuse point at each end. They are deposited in pairs, but separated by a strip of wood, which is wider —and thus causes the eggs to be further apart—at the bottom of the grooves than at their commencement. The punctured twigs bear the appearance of Figure 9, and frequently break off and die, though the great majority remain green and recover from their wounds. Indeed, there is every reason to believe that the eggs seldom hatch in those twigs which break off and become dry, but that the life and moisture of the twig is essential to their life and development of the egg, for the eggs are noticeably larger just before hatching than when first deposited, showing that they are, to a certain extent, nourished by the living wood, as is the case with those of many Saw-flies. Mr. Rathvon has also recorded the fact that the Cicada eggs are always shriveled in twigs that are amputated by the Oak-pruner (*Stenocorus villosus*, Fabr.) In the healing of the punctured parts a knot usually forms over each puncture, and I represent, at Figure 10, a portion of an apple twig, sent to me by Mr. John P. McCartney, of Cameron, in Clinton county, and which was punctured in the year 1862. Though the wounds had so well healed on the outside, the grooves inside were not filled up, but still contained the minute glistening egg-shells, from which the young larvæ had escaped six years before.

The eggs hatch between the 20th of July and the 1st of August or in about six weeks after being deposited. The newly hatched larva (Fig. 11) differs considerably from the full grown larva, but principally in having much longer and distinctly 8-jointed antennæ.* It is quite active, and moves its antennæ as dexterously and as rapidly as does an ant. As soon as it has extricated itself from an exceedingly fine membrane, which still envelops it after it has left the egg,† our little Cicada drops deliberately to the ground; its specific gravity being so insignificant, that it falls through the air as gently and as softly as does a feather.

[Fig. 11.]



The cross veins near the tip end of the upper wings of the Periodical Cicada form a dusky zig-zag mark in the shape of a W. Some ignorant persons are silly enough to believe that this mark portends

*There is frequently a ninth joint partly developed.

†All young Grasshoppers and Katydids that I have ever hatched were invariably enveloped in a like membrane after leaving the egg, and until this is thrown off the young insect is awkward in its motions. In the case of the young Cicada, these fine membranes are usually left attached to the roughened orifice of their nidus, and thus form, together, a white glistening bunch.

war. It occurs alike, though not to such a marked degree, on all other Cicadas, and if people must have an omen let them rather take the two W's for *warm weather*, and it will not be likely to disappoint them.

ENEMIES OF THE CICADA.

Upon leaving the ground to transform, the pupæ are attacked by different quadrupeds, by birds, by cannibal insects, such as Ground-beetles, Dragon-flies, Soldier-bugs, etc.; while hogs and poultry of all kinds greedily feast upon them. In the perfect fly state they are attacked by at least one insect parasite; for dipterous maggots (the larvæ, probably, of some Tachina fly) may occasionally be found in their bodies. In this state they are also often attacked by a peculiar fungus, which was first described by Dr. Leidy, in the Proceedings of the Philadelphia Academy of Natural Sciences for 1851. Dr. W. D. Hartman, of Westchester, Pa., speaking of the occurrence of this fungus, in 1851, says: "The posterior part of the abdomen, in a large number of male locusts, was filled by a greenish fungus. * * * The abdomen of the infected males was unusually inflated, dry and brittle, *and totally dead while the insect was yet flying about.* Upon breaking off the hind part of the abdomen, the dust-like spores would fly as from a small puff-ball." One male specimen received the present year from Pennsylvania was affected by the same, or a similar fungus, the internal parts of the abdomen being converted into what appeared to be a brown mould.

R. H. Warder, of Cleves, Ohio, in speaking of this mould says: It seemed to be a drying up of the contents and membranes of the abdomen, generally of a brown color, and dry and brittle. I found that in many cases the male organs of generation remained so firmly attached to the female during copulation that the male could only disengage himself by breaking away, leaving one or two posterior joints attached to the female, and it is these mutilated males which I found affected by the peculiar fungus mentioned, and therefore concluded that the "dry rot" might be the result of the broken membranes. I never found one thus affected in the very early part of their season, and I never found a perfect male thus affected. But this is not positive proof.

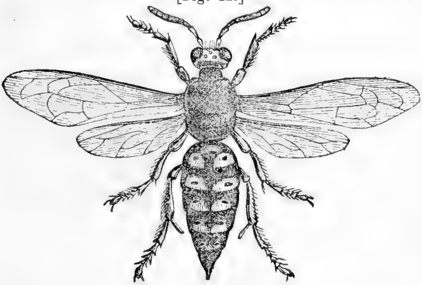
THE STING OF THE PERIODICAL CICADA.

It is astonishing what a wide-spread fear exists of the Cicada on account of its stinging powers. There is scarcely a paper in the United States but published some account of a "locust" sting last summer, while unpublished accounts were equally numerous. One of the editors of the St. Louis *Republican* was kind enough to clip out for me all accounts of such stings, which he found in their numerous exchanges, and the number which had accumulated,

before the end of the "Locust" season, was truly surprising. Some people even denied themselves the pleasure of eating blackberries, raspberries and other fruits, because they feared these fruits had been poisoned by the eggs of Cicadas; while others believed that they poisoned water. I have endeavored to trace up a number of these reports, but have invariably found that they were either false or greatly exaggerated, and there is no doubt whatever that the great majority of such accounts owe their origin to the fertile imaginations of newspaper reporters, who are ever ready to create a sensation. Yet, to use a common metaphor, it is strange there should be so much smoke and no fire, and I will briefly review the only three methods by which such stinging can possibly be produced. At the same time, I give it as my conviction that there is but little cause for fear, as I have handled hundreds of them, and know hundreds of persons, including children, who have done the same, and yet have never been able myself to witness a single case of *bona fide* stinging,

BY HORNETS.—There is a very large Digger wasp (*Stizus grandis*, Say), represented of the natural size in the accompanying Figure 12, whose peculiar habit it is to provision its nests with Cicadas. The burrows made by this Digger wasp, or hornet, are about three feet long, with two or three galleries about one foot long, each terminating in a chamber considerably enlarged. The female catches a Cicada which she stings and paralyzes, and drags into one of these chambers; and it is not very unlikely that she should occasionally alight on some human being with a Cicada in her grasp, and upon being brushed off, should retaliate by stinging the offender, and then fly off, leaving the Cicada behind, which, in absence of the hornet, would very naturally be accused of the sting. An allied species of Digger wasp (the *Stizus speciosus* of Say) has been actually observed, by Mr. Rathvon, to carry off a few belated individuals of the Periodical Cicada; but the usual prey of both these species is the larger annual Cicada (*C. pruinosa*, Say), and they both occur too late in the season to be the cause of all the stinging we hear of.

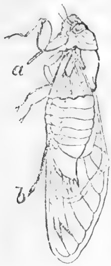
[Fig. 12.]



BY THE OVIPOSITOR.—The ovipositor of the female (Fig. 13, *b*) is certainly capable of inflicting a wound, but the Cicada is anything but pugnacious, and when not in the act of ovipositing, this instrument is securely enclosed in its sheath. That this is the stinging instrument is rendered extremely doubtful, for the following reasons: 1st. All the stinging we hear of has been done suddenly, while the

insertion of the ovipositor would necessarily be a gradual operation, requiring at least one minute ; 2d. The real function of the ovipositor is to convey an egg into the wound which it makes, and I have been unable to trace a single case where eggs were found in the flesh. All such accounts have proved to be fabrications, and the straightforward report which Mr. V. T. Chambers, of Covington, Ky., gave inthe August number of the *American Naturalist*, of a negro being stung on the foot by a Cicada, proved, after all, to be a mistake, for "Mr. Winston did not see the insect with its instrument *in situ ;*" 3d the three following facts, which are reliable, prove that stinging in the usual sense of the term, by this instrument is almost impossible: First, Mr. Wm. Muir, associate editor of Colman's *Rural World*, carefully lifted a female from off a tree, while she was yet in the act of ovipositing, and as carefully placed her on his little finger, holding it as near as possible in the same direction and position as the branch grew from which she was taken. She instinctively endeavored to continue ovipositing, and, holding firmly to his finger, tried again and again to insert the ovipositor, but without the least success, for it could not make the least impression on the soft and yielding flesh, but continually slipped from one side to the other. Second, it is recorded that Mr. Peter A. Brown, of Philadelphia, Pa., himself inflicted a puncture with the ovipositor, several times, upon his hand, without experiencing any more pain than that produced by a prick of a pin or any other pointed instrument, and that no swelling ensued; third, Dr. Hartman, of Pennsylvania, introduced some of the moisture from the ovipositor into an open wound and it caused no inflammation whatever.

[Fig. 13.]



By the Beak, or Haustellum.—The beak (Fig. 13, *a*) is an organ which both sexes of the Cicada possess, and by which they take their nourishment. I have seen them insert it into and extricate it from the branches of different trees, and know that the operation is quite rapid, and that the instrument must be quite sharp and strong. All the more authentic cases of stinging, indicate this to be the instrument,* and it is quite likely that, just as the sting of a bee will affect some persons nigh unto death, and have no effect whatever on others, so the puncture of the beak of a Cicada will be more serious with some than with others. That there is no poison

*Mr. D. B. Wier, of Lacon, Ills., who well knows the difference between the male and female Cicada, recollects distinctly, that when they were there in 1854, he was stung in the finger by the male, the sting not causing very severe pain.

Mr. R. T. Parker, of St. James, Phelps county, Mo., an intelligent fruit grower, who has given some time to the study of insects, informed me that he was stung on the neck by a male Cicada, evidently with the beak, and that the sting was not so painful as that of a bee.

Dr. M. M. Kenzie, of Centerville, Reynolds county, Mo., has communicated the fact that Frank Smith, aged 14 years, living on Henpeck, in the lower part of Reynolds county, was stung by a Cicada on the back of the left hand. The wound healed by first intention, and the next morning there was only a black clot, *about the size of a pin's head,* to mark its place, with scarcely any swelling.

gland attached to this beak, is no argument against its stinging power for several true Bugs are known to produce severe stings by their beaks, while the hairs and spines of some caterpillars have a similar power.

THE INJURY WHICH CICADAS CAUSE TO FRUIT TREES.—REMEDIES.

While living under ground they have been accused of killing pear trees, and more especially by Miss Margaretta H. Morris, in accounts of them published in 1846. The late Dr. Smith, of Baltimore, however, who made extensive operations, denied their being capable of such injury. He says:

"The larva obtains its food from the small vegetable radicals that everywhere pervade the fertile earth. It takes its food from the surface of these roots, consisting of the moist exudation (like animal perspiration), for which purpose its rostrum or snout is provided with three exceedingly delicate capillaries or hairs which project from the tube of the snout, and sweep over the surface, gathering up the minute drops of moisture. This is its only food. The mode of taking it can be seen by a good glass."—*In Prairie Farmer, December*, 1851.

While they can, if they wish, insert their beaks into roots, and very likely do so in some cases, yet I incline to believe, that Dr. Smith's views are correct, for though Dr. Hull, of Alton, Illinois, has often found them firmly attached to different roots by the legs, he has never found the beaks inserted. The fact that they will rise from land which has been cleared of timber, cultivated, and even built upon for over a dozen years, certainly contravenes Miss Morris's statement, while their long subterranean existence precludes the necessity of rapid suction. It is also quite certain that if they thus killed trees, we should oftener hear of it, and I have captured a gigantic but unnamed species of Cicada on the plains of Colorado, 50 miles from any tree, other than a few scattering willows.

In the perfect state, however, the female is capable of doing great injury to trees by hacking up their twigs, in the process of depositing, and although their injury in the forest is not generally felt, it is a very different thing in our orchards, and especially in the nursery.

The following editorial from the old *Valley Farmer* of November, 1855, will show how serious the injury may sometimes be:

"We planted an orchard of the best varieties of apple trees last spring. We had taken particular pains, not only in selecting the best varieties, but in planting the trees, and hoped in a few years to partake of the fruit. But our hopes were destined to be blasted. The locusts during the summer destroyed nearly all of them; not one in six is living. To look at them one would think that some person had been drawing the teeth of a saw over the bark of every tree."

It also appears that in some instances they injure trees by the

insertion of their beaks for nourishment, for Mr. Gustavus Pauls, of Eureka, had a young apricot tree which was so thoroughly punctured in this manner, that he took a gallon of coajulated sap from it, and he attributes the death of some of his trees to this cause. I am convinced, however, that the injury done in this manner is comparatively trifling.

On the 13th of June I was sent for by four different parties in St. Louis county, who wished me to try and save their trees from the ruinous work of these cicadas, which had by this time began to deposit their eggs in real earnest. I found that when the wind was high they could, by its aid, be driven to some extent, but that without its aid they could not be driven at all; as when started, they are just as likely to fly behind as before you. I tried lye, whitewash and sulphur, air-slacked lime and finally carbolic acid, and found that none of these mixtures would affect them. Indeed, after experiments involving about $200, I am convinced that there is no available way of entirely preventing this ruinous work when they once commence to deposit. The nursery of Mr. Stephen Partridge, a few miles west of St. Louis, which is surrounded on all sides by timber, was more seriously injured than any other which I saw, and he lost many hundred dollars' worth of apple, peach and pear stock. They also punctured his grape vines very freely, preferring the Clinton and Taylor among varieties. By having all hands turn out early in the morning, and between six and seven o'clock in the evening, while they hung listlessly to the branches, he succeeded in crushing thousands of them, and thus saved parts of his nursery from total ruin. But it becomes a hopeless task to try to stay their disastrous work when once they have acquired full power of flight; though, while in their feeble and helpless condition, as they leave the ground, they can not only be destroyed to far greater advantage by human agency, but hogs and poultry of all kinds, eagerly devour them. There were, it is true, many accounts afloat last summer of hogs being poisoned by them, and, though it is not impossible that one was occasionally killed by over-glutting,* such cases were very rare indeed. From the foregoing, the importance of knowing beforehand when to expect them becomes apparent, and the following chronological table, will not only prove of great scientific interest but of practical value. In the greater part of Missouri, the fruit grower may rest from all anxiety as to their appearance for thirteen years to come, but in the month of May, 1881, let him look out for them.

THEIR CHRONOLOGICAL HISTORY, WITH PREDICTIONS OF THE FUTURE APPEARANCE OF ALL WELL ASCERTAINED BROODS THROUGHOUT THE COUNTRY.

As nothing had been published up to A. D. 1868, as to the regular appearance of any thirteen year broods of Cicadas, it is not at

* Mr. F. R. Allen, of Allenton, informs me that during years when the army worm (*Leucania unipuncta*, Haw.) occurred in such swarms, hogs and chickens feasted on them to such an extent that the former frequently died, while the latter laid eggs in which the parts naturally white would be entirely green when cooked.

all surprising that errors were committed by former writers on the subject. In the following chronology of this insects periodical visits, everything heretofore published has been revised as far as possible. The mass of facts from which the generalizations are made would be tedious if given in detail, and are therefore for the most part omitted. This chronology could not, of course, be made complete from a single season's researches, and it may even contain errors, but it will remain as a foundation for future work, and before another seventeen years shall have passed away, we may hope to have this part of the history of our curious Cicadas completed and perfected.

While the discovery of the thirteen year broods, dispelled much of the fog in which this chronology had hitherto been wrapped, it at the same time, rendered a complete and lucid exposition of that chronology extremely difficult. The northern boundary line of the thirteen year broods is about latitude 37°, but in Illinois one of them ascends between two and three degrees above this line, while the seventeen year broods descend below it in several places, the two broods sometimes occupying the Carolina. Thus the two broods sometimes occupy the same territory; while two broods of the same kind, appearing in different years may also overlap one another, as in the instance given in the account of brood XXII in Virginia, where the "locusts" appear every eighth and ninth year. In order to make the subject as clear as possible, and to facilitate references, I have numbered the different broods of this insect in accordance with the date of their future appearance from and after the present year.

BROOD I.—*Septemdecim*—1852, 1869.

In the year 1869, and at intervals of seventeen years thereafter, they will, in all probability, appear in the valley of the Connecticut river. According to Dr. Asa Fitch (N. Y. Rep. I, p. 40), they appeared there in 1818 and 1835, and according to Dr. Smith they occurred in Franklin, Bristol and Hampshire counties, Massachusetts, in 1767, '84, 1801, '18, '35 and '52.

BROOD II.—*Tredecim*—1856, 1869.

In the year 1869, being the same as the preceding, they will in all probability appear in Georgia, in Habersham, Rabun? Muscogee, Jasper, Greene, Washington and adjacent counties, having appeared there in 1843 and 1856, according to Dr. Smith.

BROOD III.—*Septemdecim*—1853, 1870.

In the year 1870, and at intervals of seventeen years thereafter, they will in all probability appear in what is known as the "Kreitz Creek Valley" in York county, Pa., and possibly in Vinton county, Ohio, and Jo. Daviess county, Ills. Mr. S. S. Rathvon, of Lancaster, Pa., speaking of this brood, says: "Lancaster county is bounded on the southwest by the Susquehanna river, dividing it from the county

of York, along the northeastern margin of which there is a mountain range, sloping down to the river. Along that slope Cicadas were abundant the present season (1868—Brood XXII). But on the southwest side of the range, in what is known as the Kreitz Creek Valley, there were none. They appeared last in this valley in 1853, and previous to that year at intervals of seventeen years from time immemorial." Dr. Smith records their appearance in 1853, both in Vinton county, Ohio, and Jo. Daviess county, Illinois.

BROOD IV.—*Tredecim*—1857, 1870.

In the year 1870, being the same as the preceding, they will in all probability appear in Jackson, Gadsden and Washington counties, Florida, having appeared there according to Dr. Smith in 1844 and 57.

BROOD V.—*Septemdecim*—1854, 1871.

In the year 1871, and at intervals of 17 years thereafter, they will in all probability appear around the head of Lake Michigan, extending as far east as the middle of the State of Michigan, and west an unknown distance into Iowa. Also in Walworth county and other portions of Southern Wisconsin, and southward into Illinois. This brood is equal to Dr. Fitch's 6th. It extends all over Northern Illinois, and as far south as Edgar county, and its appearance in 1837 and 1854 is well and thoroughly recorded. In Champaign county, Ills., it overlaps Brood XVIII, or the Southern Illinois *tredecim* brood, while it also interlocks with Brood XIII (*septemdecim*) in the same county.

They will also appear in the same years in the southeast by eastern part of Lancaster county, Pa., in what is called the "Pequea Valley," having appeared there in vast numbers in 1854.

The earliest known record we have of the appearance of periodcal Cicadas, is in Morton's "Memorial," in which it is stated that they appeared at Plymouth, Plymouth county, Mass., in the year 1633.—Now, according to that date, one might be led to suppose that this recorded brood of Morton's belonged to this Brood III, as exactly 14 periods of 17 years will have elapsed between 1633 and 1871; but, strange to say, we have no other records of his brood than that in the "Memorial," whereas there are abundant records of their appearing one year later in the same locality, ever since 1787. There is therefore good reason to believe that the visit recorded by Morton was a premature one, and that it was properly due in 1634. I have therefore placed it in Brood XIII, and have little doubt but that if records could be found, these would prove the Cicadas to have appeared in 1651, 1668, 1685, 1702, 1719, 1736, 1753, and 1770, as they did in 1787, 1804, 1821, 1838, and 1855.

BROOD VI.—*Tredecim*—1858, 1871.

In the year 1871, being the same year as the preceding, and at intervals of 13 years thereafter, they will in all probability appear in

the extreme southwestern corner of Mississippi, and in the adjoining part of Louisiana. Dr. D. L. Phares of Newtonia (near Woodville), Miss., says that in 1858 they extended over most of Wilkinson and part of Amite counties, Mississippi, and East and West Feliciana, La. He has himself witnessed the appearance of this brood during the years 1832, 1845 and 1858, while it is distinctly remembered by aged people in his neighborhood as having also appeared there in the years 1806 and 1819. Dr. Smith gives their range from the Mississippi river, east to a ridge 45 miles from the river that divides the State, north and south, and north and south to the boundaries of the State; recording them as occurring in 1806, '19, '32, '45 and '58.

BROOD VII.—*Tredecim*—1859, 1872.

In the year 1872, and at intervals of 13 years thereafter, they will in all probability appear in Jackson county and around Cobden and Jonesboro, in Union county, South Illinois, in Kansas, Missouri, Georgia, Louisiana, Tennessee and Mississippi.

According to Mr. Paul Frick of Jonesboro, they were in Union county, Ills., in 1858, and he also thinks it was a great year for them *about* 1832. Those of 1858 were probably premature stragglers of the 1859 brood, while Mr. Frick is most likely mistaken as to the year 1832, since the Rev. George W. Ferrell of Cobden, Union county, witnessed their appearance at that place in 1833, and also in 1846 and 1859; and Cyrus Thomas has also recorded their appearance in 1859 in the 5th Rep. of the Ills. State Agr. Soc., p. 458*, while a paragraph in the Baltimore (Md.) *Sun* of June 13, 1859 says "the locusts have made their appearance in 'Egypt' in Southern Illinois, and cover woods and orchards in swarms." This brood not improbably extends westward into Missouri, for several of the old settlers around Eureka, in St. Louis county, Mo., recollect it being "locust year" about the time of its last appearance, while Mr. L. D. Votaw of Eureka, and Wm. Muir of Fox Creek, Mo., both believe it was exactly 9 years ago, or in the year 1859. Dr. Smith records it in DeKalb, Gwinnett and Newton counties, Georgia, in 1846 and '59; in the northern part of Tennessee also, in 1846 and '59; in the whole eastern portion of Mississippi from the ridge which is 45 miles from the river, on the west, to the eastern boundary, in 1820, '33, '46, and '59; in Carrol Parish, Louisiana, in 1859; and in Philips county, Kansas, in the same year.

By referring to Brood XV, it will be seen that in 1846, or during the first year of the Mexican war, this 13-year brood appeared simultaneously with a 17-year brood in western Pennsylvania and Ohio.

* If Mr. Paul Frick is correct, the brood he has witnessed may possibly be a detachment of the Mississippi and Louisiana Brood VI; in which case the Cicadas appear for two consecutive years in Union county, Ills., as they do (See Broods XIII and XIV) in Central Ohio, and portions of Northwestern Missouri.

BROOD VIII.—*Septemdecim*—1855, 1872.

In the year 1872, being the same year as the preceding, and at intervals of 17 years thereafter, they will, in all probability, appear in the southeastern part of Massachusetts; across Long Island; along the Atlantic coast to Chesapeake Bay, and up the Susquehanna at least as far as to Carlisle in Pennsylvania; also, in Kentucky, at Kanawha in Virginia, and Gallipolis, Ohio, on the Ohio river. This is the brood referred to in Brood V, and which there is every reason to believe is the one recorded by Morton in his "Memorial," as occurring in 1633.

Dr. Fitch, in the account of his 3d brood (N. Y. Rep. I, p. 39), says: "The third brood appears to have the most extensive geographical range. From the southeastern part of Massachusetts, it extends across Long Island, and along the Atlantic coast to Chesapeake Bay, and up the Susquehanna at least as far as to Carlisle in Pennsylvania; and it probably reaches continuously west to the Ohio, for it occupies the valley of that river at Kanawha in Virginia, and onwards to its mouth, and down the valley of the Mississippi probably to its mouth, and up its tributaries, west, into the Indian Territory. This brood has appeared the present year, 1855, and I have received specimens from Long Island, from South Illinois, and the Creek Indian country west of Arkansas," etc.

There is every reason to believe that Dr. Fitch, in this account, has confounded this *septemdecim* Brood VIII, with the great *tredecim* Brood XVIII, for it so happened that they both occurred simultaneously in 1855, but the exact dividing line of these two broods is not so easily ascertained. Certainly, after reaching the Ohio river, the *septemdecim* brood extends beyond Gallipolis, Ohio, for Prof. Potter, in his "Notes on the Cicada decem septima," records their appearance at that place in 1821; and Dr. Smith records their appearance at Frankfort, Lexington and Flemingsburg, Kentucky, in 1838, and 1855. But I strongly incline to believe that well nigh the rest of the territory mentioned by Dr. Fitch was occupied by the *tredecim* brood, the reasons for which belief will be found in the account of brood XVIII.

Cicadas also appeared in Buncombe and McDowell counties, North Carolina, in 1855, but until they appear there again it will be impossible to say, positively, whether they belong to this *septemdecim* Brood VIII, or to the *tredecim* Brood XVIII.

BROOD IX—*Septemdecim*—1857, 1874.

In the year 1874, and at intervals of 17 years thereafter, they will propably occur in southeast Nebraska.

The occurrence of this brood was communicated to me by Mr. Clarke Irvine, of Oregon, Holt county. The brood is most likely confined to the eastern or timbered portion of the State, and I judge it to be *septemdecim*, from the fact that the latitude is rather more northerly than tredecim is known to occur.

BROOD X—*Tredecim*—1862, 1875.

In the year 1875, and at intervals of 13 years thereafter, they will most likely occur in different parts of Texas. According to Dr. Smith they appeared in vast numbers in some parts of Texas in 1849, though he was not able to get any particulars.

BROOD XI—*Septemdecim*—1859, 1876.

In the year 1876, and at intervals of 17 years thereafter, they will in all probability appear in parts of North Carolina, Virginia, Maryland, Illinois and Indiana. According to Dr. Smith they appeared from Raleigh, North Carolina, to near Petersburg, Virginia, in 1842 and 1859; in Rowan, Davie, Cabarras and Iredell counties in the same State in 1825, 1842 and 1859; in the valley of Virginia as far as the Blue Ridge on the east, the Potomac river on the north, the Tennessee and North Carolina lines on the south, and for several counties west, in 1808, 1842 and 1859; in the south part of St. Mary's county, Maryland, dividing the county about midway east and west, in 1825, 1842 and 1859; in Illinois about Alton in 1842 and 1859; and in Sullivan and Knox counties, Indiana, in 1842 and 1859.

BROOD XII—*Septemdecim*—1860, 1877.

In the year 1877, and at intervals of 17 years thereafter, they will, in all probability, appear in the vicinity of Schuylerville and Fort Miller, in New York. From thence along both sides of the Hudson to its mouth, where they extend, at least, to New Haven, in Connecticut, and west across the north part of New Jersey and into Pennsylvania. Also in Dearborn county, Indiana; Kalamazoo, Michigan; in Pennsylvania, North Carolina, Virginia and Maryland.

This brood is recorded by Prof. Potter as having occurred at North Haven, Conn., in 1724, 1741, 1758, 1792, 1809 and 1826. It was also recorded by the same writer as having occurred in 1826 in Middlesex county, N. J., and by Dr. Fitch as having occurred in 1843 throughout the whole country mentioned above. In 1860, again, it was spoken of in the old series of the *Prairie Farmer* (Vol. 22, p. 119) as having occurred that year in New Jersey, and Dr. Smith records it throughout the whole State in 1775, 1792, 1809, 1826 and 1843. Mr. Jas. Angus, of West Farms, Westchester county, N. Y., has himself witnessed its recurrence in the years 1843 and 1860.

In Pennsylvania, Mr. Rathvon found a few individuals in 1860, and Dr. Smith says it extends from the Susquehanna to the Delaware river, bounded by Peter's mountain on the south. In Virginia it occurred from the south part of Loudon county to the Roanoke river, and from the Blue Ridge to the Potomac in 1826, 1843 and 1860. In Maryland from Ann Arundel county to the north part of St. Mary's, and from the Potomac to Chesapeake Bay, in 1809, 1826, 1843 and 1860. In Rockingham, Stokes, Guilford, Rowan, Surrey and adjacent

counties, North Carolina, in 1792, 1809, 1826 and 1843. In Dearborn county, Indiana, in 1843 and in 1860, and in Kalamazoo, Michigan, during the same years.

BROOD XIII.—*Septemdecim*—1861, 1878.

In the year 1878, and at intervals of 17 years thereafter, they will, in all probability, appear along the centre of the State of Illinois, all along the southern part of Iowa, and around St. Joseph, in Buchanan county, in North Missouri.

The records are abundant, of their appearance, in 1844 and 1861, all along the southern border of Iowa, and in Mason, Fulton, McDonough and Champaign counties in Central Illinois. In 1861 they also occurred in Champaign county, Central Ohio, and in Buchanan county, Northwest Missouri; and this brood not unlikely occupies, more or less, the whole strip of country between these two points. Their appearance in 1861 was associated with the first year of the rebellion; and Dr. Smith records this brood both in Illinois and Iowa in 1844.

BROOD XIV.—*Septemdecim*—1862, 1879.

In the year 1879, and at intervals of 17 years thereafter, they will, in all probability, appear in the whole of western Missouri, commencing south about Johnson and Saline counties, and extending in a northwesterly direction to Lawrence and above, in Kansas, south to Arkansas, and west an unknown distance into Kansas; also, in Central Ohio.

The occurrence of this brood in 1845 and 1862 is well remembered by several of my correspondents, and is recorded by Dr. Smith. At St. Joseph, in Buchanan county, Mo., Cicadas were not so thick in 1862 as in 1861. Had it been the reverse, or, in other words, had they been more numerous in 1862 than in 1861, I should have been inclined to record the visit of 1861 as but a precursor to this Brood X; but as it is, I believe the two broods are distinct, and that they occur for two consecutive years, both in Central Ohio and in portions of Northwest Missouri.

This brood has not been traced further east, in Missouri, than Saline county, and yet a detachment of it certainly occurs in Ohio, for Mr. Clarke Irvine, of Oregon, Holt county, Mo., well remembers their occurrence in Central Ohio in 1845 and 1862. Though there is no knowledge of the appearance of this Brood XIV in Illinois, yet the fact of its occurring both in Ohio and in North Missouri, and that, too, but one year after Brood XIII, would indicate that there may have been, in times past, at all events, if there is not at the present day, a geographical connection between these two broods.

BROOD XV.—*Septemdecim*—1863, 1880.

In the year 1880, and at intervals of 17 years thereafter, they will, in all probability, appear from western Pennsylvania to Sciota river,

east, and down the valley of the Ohio river as far as Lewis county, in Virginia.

This brood is recorded in Ohio as far back as the year 1812, by "A. M. B.," writing to the Chicago *Tribune*, under date of June 22, 1868. Harris also records its appearance in Ohio in 1829, and they were quite numerous in Coles county, in the centre of the same State in 1846, or during the first year of the Mexican war, while Dr. Smith records it in the eastern part of the State, extending over twelve counties, west, to the Sciota river, and to Sandusky, on Lake Erie, in 1829, '46 and '63; and in Lewis county, Virginia, since 1795. As before stated this brood occurred in Ohio in 1846, simultaneously with the *tredecim* brood VII in South Illinois. Dr. Fitch, in his account of his 5th brood, also records its appearance, and states that it reached to Louisiana. But just as the *septemdecim* Brood VIII was confounded with the great *tredecim* Brood XVIII in 1855, so this *septemdecim* Brood XV was doubtless also confounded with it in 1829, for they both occurred that year. Had the western country been as thickly settled in 1829 as it was in 1855, the *tredecim* Brood XVIII could undoubtedly have been traced in Southern Illinois and Missouri, etc., in the former as it was in the latter year. This belief is furthermore greatly strengthened from our having no other record of the appearance of this *septemdecim* brood, in Louisiana, than Prof. Potter's statement that they appeared there in 1829, whereas they have occurred there since 1829 at intervals, not of 17, but of 13 years, and were there the present year, 1868, as will be seen on referring to Brood XVIII. The dividing line of these two broods (XV and XVIII) is probably the same as with broods VIII and XVIII.

BROOD XVI.—*Tredecim*—1867, 1880.

In the year 1880, being the same as the preceding, they will, in all probability, appear in the north part of Cherokee county, Georgia, having appeared there according to Dr. Smith in 1828, '41, '54, and according to Dr. Morris, in 1867. This brood occurred in 1867 simultaneously with the northern *septemdecim* brood XXI.

BROOD XVII.—*Septemdecim*—1864, 1881.

In 1881, and at intervals of 17 years thereafter, they will, in all probability, appear in Marquette and Green Lake counties, in Wisconsin, and may also appear in the western part of North Carolina, and about Wheeling, Virginia; in Northeast Ohio, and a few in Lancaster county, Pa., and Westchester county, New York.

There is abundant evidence that they appeared in the counties named in Wisconsin in 1864, and fair evidence that they appeared that year in Summit county, Northeast Ohio, while straggling specimens were found in the same year, by Mr. S. S. Rathvon, in Lancaster county, Pa., and by Mr. James Angus, in Westchester county, N. Y. Dr. Fitch also records their appearance in 1847, or 17 years previously, in

the western part of North Carolina, and Dr. Smith, in Wheeling, Virginia, in 1830, '47 and '64. The distance between the localities given is very great, and it is doubtful whether all these records belong to one and the same brood.

BROOD XVIII.—*Tredeim*—1868, 1881.

In the year 1881, and at intervals of 13 years thereafter, they will, in all probability, appear in Southern Illinois, throughout Missouri, with the exception of the northwestern corner, in Louisiana, Arkansas, Indian Territory, Kentucky, Tennessee, Mississippi, Alabama, Georgia, and North and South Carolinas.

Though, as already stated, I published the first account ever given of the existence of a 13-year brood, yet, besides the others mentioned in this chronology, this particular brood has been traced since, as having occurred in the years 1816, '29, '42, '55 and '68; and Mr. L. W. Lyon, at the July (1868) meeting of the Alton, (Ills.) Horticultural Society, even mentioned its appearance in 1803.

In Missouri, it occurs more or less throughout the whole State with the exception of the northwest corner that is bounded on the east by Grand river, and on the south by the Missouri river.* The southeast part of the State, where Dr. Smith has recorded it since 1829, is most thickly occupied. I enumerate those counties in which there is undoubted evidence of their appearance during the present year (1868) viz.: Audrain, Bollinger, Benton, Clarke, Chariton, Callaway, Cooper, Cole, Franklin, Gasconade, Iron, Jefferson, Knox, Lewis, Marion, Macon, Morgan, Moniteau, Pike, Phelps, Pulaski, Polk, Pettis, Schuyler, St. Charles, St. Louis, St. Francois, St. Clair, Warren, and Washington.

It not improbably overlaps some of the territory occupied by the *septemdecim* Brood XIV, but I do not think it extends into Kansas.

In Illinois it occurs more or less throughout the whole southern half of the State, but more especially occupies the counties from the south part of Adams county along the Mississippi to the Ohio, up the Ohio and Wabash rivers to Edgar county, and then across the centre of the State, leaving some of the central counties in South Illinois unoccupied. To be more explicit, I enumerate all the counties in which it undoubtedly occurred during the present year (1868): Adams (south part, back of Quincy), Bond, Clinton (northwest corner, adjacent to Madison), Champaign, Coles, Crawford, Cumberland, Clay, Clark, Edwards, Edgar† (especially in the eastern part), Franklin, Gallatin, Hardin, Hamilton, Johnson, Jasper, Jersey, Jefferson, Lawrence, McLean (east end), Macon, Madison, Marion, Massac, Monroe,

*As Mr. Wm. Raucher, of Oregon, Holt county, saw a few individuals in the northeast part of Buchanan county in 1855, it may occur in small numbers in districts even north of the Missouri river.

† Edgar county also has the *septemdecim* Brood III.

Pike, Perry, Piatt, Pope, Richland, Randolph, Sangamon, Saline, St. Clair, Union (northeast corner), Washington, Wayne, Wabash, Williamson and White. There were none the present year, either at Decatur, in Macon county, or at Pana in Christian county; nor were there any at Bloomington or Normal, in McLean; nor in Dewitt county, which lies south of McLean; nor in Spring Creek, Iroquois county, which is northeast of Champaign.

In Kentucky, according to Dr. Smith, it occurred in the northwest corner of the State, about Paducah and adjacent counties south, in 1829, '42, and '55, and it occurred there in 1868.

In Arkansas, it occupied all the northern counties in 1842, '55 and '68.

In Alabama, it occupied Russell and adjacent counties on the east side of Black Warrior river, in 1842, '55 and '68.

In Tennessee, it occupied Davidson, Montgomery, Bedford, Williamson, Rutherford and adjacent counties in 1842, '55* and '68.

In North Carolina, it appeared in Mecklenburg county, in 1829, '42, '55 and '68.

In South Carolina, the Chester district and all the adjoining country to the Georgia line, west, and to the North Carolina line, north, was occupied with it in 1816, '29, '42, '55 and '68.

In Georgia, it has occurred in Cherokee county since the year 1816.

In Louisiana, it appeared in Morehouse, Caddo, Clairborne, Washington and adjacent parishes, in 1855 and '68.

It also doubtless occurs in Mississippi and Indian Territory, though I am unable to specify any localities.

BROOD XIX.—*Septemdecim*—1865, 1882.

In the year 1882, and at intervals of 17 years thereafter, they will, in all probability, appear in Monroe, Livingston, Madison and adjacent counties, and around Cayuga Lake, in New York.

Mr. T. T. Southwick, of Manlius, Livingston county, records their appearance there in 1865, and, as will be seen by referring to the *Prairie Farmer*, vol. 16, p. 2, they appeared during the same year near Cayuga Lake, while Dr. Smith records their appearance in 1797, 1814, '31 and 48.

BROOD XX.—*Septemdecim*—1866, 1883.

In the year 1883, and at intervals of 17 years thereafter, they will, in all probability, appear in western New York, western Pennsylvania and eastern Ohio. In the last mentioned State they occur more especially in Mahoning, Carroll, Trumbull, Columbiana and adjacent counties, overlapping, especially in Columbiana county, some of the

* Though they occurred in large numbers in Davidson county and other portions of Tennessee in 1855, and also the present year, yet in Lawrence county they appeared in 1856, instead of 1855—another instance of a belated brood.

territory occupied by Brood XV. In Pennsylvania, they occupy nearly all the western counties, and their appearance is recorded in 1832, '49 and '66, by Dr. Fitch (his second brood), Dr. Smith, and several of my correspondents; the following counties being enumerated: Armstrong, Clarion, Jefferson, Chemung, Huntingdon, Cambria, Indiana, Butler, Mercer and Beaver.

BROOD XXI.—*Septemdecim*—1867, 1884.

In the year 1884, and at intervals of 17 years thereafter, they will, in all probability, appear in certain parts of North Carolina and Central Virginia. In 1850 and 1867 they appeared near Wilkesboro N. C., and were also in Central Virginia during the last mentioned year, while Dr. Smith mentions them as occurring in Monroe county, and the adjacent territory, in Virginia in 1833 and 1850.

Dr. Harris (Inj. Insects, p. 210) records their appearance at Martha's Vineyard, Massachusetts, in 1833, but as I cannot learn that they were there, either in 1850 or 1867, I infer that Dr. Harris's informant was mistaken.

BROOD XXII.—*Septemdecim*—1868, 1885.

In the year 1885, and at intervals of 17 years thereafter, they will, in all probability, appear on Long Island; at Brooklyn, in Kings county, and at Rochester in Monroe county, New York; at Fall River, and in the southeastern portion of Massachusetts; at Oakland (Rutland?), Vermont; in Pennsylvania, Maryland, District of Columbia, Delaware and Virginia; in northwestern Ohio, in southeastern Michigan, in Indiana and Kentucky.

This brood has been well recorded in the East in 1715, 1732, 1749, 1766, 1783, 1800, 1817, 1834, 1851 and 1868. It is spoken of in "Hazzard's Register" for 1834, published in Philadelphia, while Mr. Rathvon has himself witnessed its occurrence during the four latter years in Lancaster county, Pa.

It is the fourth brood of Dr. Fitch, who only says that it "reaches from Pennsylvania and Maryland to South Carolina and Georgia, and what appears to be a detached branch of it occurs in the southeastern part of Massachusetts." He is evidently wrong as to its occurring in South Carolina and Georgia, and it is strange that he does not mention its appearance in New York, for Mr. F. W. Collins, of Rochester, in that State, has witnessed four returns of it there, namely: in 1817, '34, '51 and '68, while the Brooklyn papers record its appearance there the present season. As these two points in the State are about as far apart as they well can be, the intervening country is probably more or less occupied with this brood. Mr. H. Rutherford, of Oakland,* Vermont, records their appearance in that neighborhood in 1851 and 1868.

*I can find no such post office as Oakland in Vermont, and incline to believe that the *Tribune* compositor made Oakland out of Rutland, and more especially as Rutland is on the New York border.

(N. Y. Semi-Weekly *Tribune*, June 27). He also witnessed them in the same place in 1855, and as will be seen by referring to Brood XVIII, they also occurred on Long Island and in southeastern Massachusetts in that same year, 1855. Exactly 13 years intervening between 1855 and 1868, one might be led to suppose that they had a *tredecim* brood in the East. But did such a brood exist, it would certainly have been discovered ere this, in such old settled parts of the country, and all the records go to show that they have nothing but *septemdecim* there. By referring to Brood VIII, the mystery is readily solved, for we find that in that part of the country there are two *septemdecim* broods—the one having last appeared in 1855—the other the present year, 1868.

In Ohio, this brood occurred more or less throughout the whole western portion of the State, for our correspondents record them as having appeared in 1868 in Lucas and Hamilton and several intervening counties. Mr. F. C. Hill, of Yellow Springs, in Green county, Southwest Ohio, has witnessed their appearance in 1834, 1851 and 1868, and they occurred in the northwestern part of the State during the three same years; while the correspondent to the Department of Agriculture, from Toledo, Northwest Ohio (July, 1868, Monthly Rep.), says it is their 9th recorded visit there. Dr. Smith records it as occurring around Cincinnati, in Franklin, Columbiana, Pike and Miami counties.

In Indiana, there is reliable evidence of their appearance, in 1868, in the southern part of the State, in Tippecanoe, Delaware, Vigo, Switzerland, Hendricks, Marion, Dearborn, Wayne, Floyd, Jefferson and Richmond counties. The evidence seems to show that, as in Ohio, throughout the State, they belong to this *septemdecim* Brood XXII, for Mr. F. Guy, of Sulphur Springs, Mo., has personally informed me that they were in Southern Indiana in 1851, and even in Tippecanoe county, on the Wabash river, where, from their proximity to Brood XVIII, one might have inferred them to be *tredecim*, they are recorded as appearing in 1834 and '51.

In Kentucky they appeared around Louisville. In Pennsylvania, Maryland, Delaware and Virginia, the territory occupied by this brood is thus described by Dr. Smith: "Beginning at Germantown, Pa., to the middle of Delaware; west through the east shore of Maryland to the upper part of Ann Arundel county; thence through the District of Columbia to Loudon, West Virginia, where it ☞ laps over the South Virginia district (see Brood XII) from the Potomac to Loudon county, some 10 or 12 miles in width, and in this strip of territory Cicadas appear every 8th and 9th year. Thence the line extends through the north counties of Virginia and Maryland to the Savage mountains, and thence along the south tier of counties in Pennsylvania, to Germantown."

From the above synoptical view it results that there will, during the next 17 years, be broods of the Periodical Cicada somewhere or

other in the United States in A. D. 1869, '70, '71, '72, '74, '75, '76, '77, '78, '79, '80, '81, '82, '83, '84 and '85—or every year but 1873. It further appears that the number of distinct broods, appearing in distinct years, within the following geographical districts, are as follows: In southern New England 4 broods, years '69, '72, '77 and '85; in New York 5 broods, years '72, '77, '82, '83 and '85; in New Jersey 2 broods, years '72 and '77; in Pennsylvania 7 broods, years '70, '71, '72, '77, '80, '83 and 85; in Ohio 7 broods, years '72, '78, '79, '80, 81, '83 and '85; in Indiana 4 broods, years '71, '76, '77 and '85; in Illinois 6 broods, years '71, '72*, '76, '77, '78 and '81*, and probably another in Jo Daviess county, year '70; in Wisconsin 2 broods, years '71 and '82; in Michigan 2 broods, years '71 and '85; in Iowa 2 broods, years '71 and '78; in Nebraska 1 brood, year '74; in Kansas 2 broods, years '72* and '79; in Missouri 4 broods, years '72*, 78, '79 and '81*; in Louisiana and Mississippi 3 broods, years '71*, '72* and 81*; in Tennessee 2 broods, years '72* and '81*; in Arkansas, Indian Territory and Alabama, 1 brood, year '81*; in Kentucky 3 broods, years '72, '81* and 85; in Georgia 4 broods, years '69*, '72*, '80* and '81*; in South Carolina 1 brood, year '81*; in North Carolina 6 broods, years '72?, '76, '77, '81?, '81* and '84; in East and West Virginia 5 broods, years '72, '77, '80, '81 and 84; in Maryland 4 broods, years '72, '76, 77 and 85; in District of Columbia 1 brood, year '85; in Delaware 2 broods, years '72 and 85; in Florida 1 brood, year 73*; in Texas 1 brood, year 75*.

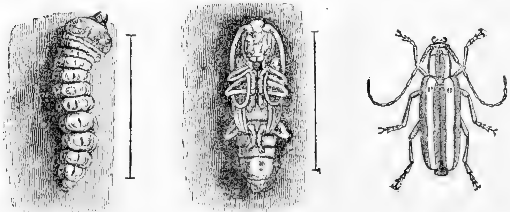
* The broods marked (*) belong to the 13-year or tredecim race of the Periodical Cicada.

APPLE-TREE BORERS.

(Coleoptera, Cerambicidæ.)

THE ROUND-HEADED APPLE-TREE BORER—*Saperda bivittata*, Say.

[Fig. 14.]



a *b* *c*

It is a fact which has not been disputed by any one whom I have queried on the subject, that apple trees on our ridges are shorter lived than those grown on our lower lands. Hitherto no particular reason has been given for this occurrence, but I think it is mainly attributable to the workings of the borer now under consideration. I

have invariably found it more plentiful in trees growing on high land than in those growing on low land, and it has also been my experience that it is worse in ploughed orchards than in those which are seeded down to grass. Fifty years ago, large, thrifty, long-lived trees were exceedingly common, and were obtained with comparatively little effort on the part of our ancestors. They had not the vast army of insect enemies to contend with, which at the present day make successful fruit-growing a scientific pursuit. This Apple-tree borer was entirely unknown until Thomas Say described it in the year 18.4; and, according to Dr. Fitch, it was not till the year following that its destructive character became known in the vicinity of Albany, N. Y., for the first time. Yet it is a native American insect, and has for ages inhabited our indigenous crabs, from which trees my friend, Mr. A. Bolter, took numerous specimens, in the vicinity of Chicago, ten years ago. It also attacks the quince, mountain ash, hawthorn, pear and the June-berry. Few persons are aware to what an alarming extent this insect is infesting the orchards in St. Louis, Jefferson and adjacent counties, and, for aught I know, throughout the State. A tree becomes unhealthy and eventually dwindles and dies, often without the owner having the least suspicion of the true cause—the gnawing worm within. Even in the orchard of the most worthy president of our State Horticultural Society, I found one or more large worms at the base of almost every tree that I examined, notwithstanding he had been of the opinion that there was not a borer of this kind on his place.

At Figure 14, this borer is represented in its three stages of larva (*a*), pupa (*b*), and perfect beetle (*c*). The beetle may be known by the popular name of the Two-striped Saperda, while its larva is best known by the name of the Round-headed apple-tree borer, in contradistinction to the Flat-headed species, which will be presently treated of.

The average length of the larva, when full-grown, is about one inch, and the width of the first segment is not quite $\frac{1}{4}$ of an inch. Its color is light yellow, with a tawny yellow spot of a more horny consistency on the first segment, which, under a lens, is found to be formed of a mass of light brown spots. The head is chestnut-brown, polished and horny, and the jaws are deep black. The pupa is of rather lighter color than the larva, and has transverse rows of minute teeth on the back, and a few at the extremity of the body; and the perfect beetle has two longitudinal white stripes between three of a light cinnamon-brown color. The Two-striped Saperda makes its appearance in the beetle state during the months of May and June, and is seldom seen by any but the entomologist who makes a point of hunting for it—from the fact that it remains quietly hidden by day and flies and moves only by night. The female deposits her eggs during the month of June, mostly at the foot of the tree, and the young worms hatch and commence boring into the bark within a fortnight

afterwards. These young worms differ in no essential from the full grown specimens, except in their very minute size; and they invariably live, for the first year of their lives, on the sap-wood and inner bark, excavating shallow, flat cavities which are found stuffed full of their sawdust-like castings. The hole by which the newly hatched worm penetrated is so very minute that it frequently fills up, though not till a few grains of castings have fallen from it; but the presence of the worms may be generally detected, especially in young trees, from the bark, under which they lie, becoming darkened, and sufficiently dry and dead to contract and form cracks. Through these cracks, some of the castings of the worm generally protrude, and fall to the ground in a little heap, and this occurs more especially in the spring of the year, when, with the rising sap and frequent rains, such castings become swollen and augment in bulk. Some authors have supposed that the worm makes these holes to push out its own excrement, and that it is forced to do this to make room for itself; but, though it may sometimes gnaw a hole for this purpose, such an instance has never come to my knowledge, and that it is necessary to the life of the worm is simply a delusion, for there are hundreds of boring insects which never have recourse to such a procedure, and this one is frequently found below the ground, where it cannot possibly thus get rid of its castings. It is currently supposed that this borer penetrates into the heart wood of the tree after the first year of its existence, whereas the Flat-headed species is supposed to remain for the most part immediately under the bark; but I find that on these points no rules can be given, for the Flat-headed species also frequently penetrates into the solid heart wood, while the species under consideration is frequently found in a full grown state just under the inner bark, or in the sap-wood. The usual course of its life, however, runs as follows:

As winter approaches, the young borer descends as near the ground as its burrow will allow, and doubtless remain inactive till the following spring. On approach of the second winter it is about one-half grown and still living on the sap-wood; and it is at this time that these borers do the most damage, for where there are 4 or 5 in a single tree, they almost completely girdle it. In the course of the next summer when it has become about three-fourths grown, it generally commences to cut a cylindrical passage upward into the solid wood, and before having finished its larval growth, it invariably extends this passage right to the bark, sometimes cutting entirely through a tree to the opposite side from which it commenced; sometime turning back at different angles. It then stuffs the upper end of the passage with sawdust-like powder, and the lower part with curly fibres of wood, after which it rests from its labors. It thus finishes its gnawing work during the commencement of the 3d winter, but remains motionless in the larval state till the following spring when it casts off its skin once more and becomes a pupa. After resting three

weeks in the pupa state it becomes a beetle, with all it members and parts at first soft and weak. These gradually harden and in a fortnight more it cuts its way through its sawdust-like castings, and issues from the tree through a perfectly smooth and round hole. Thus it is in the tree a few days less than three years, and not merely two years as Dr. Fitch suggests. I have come to this conclusion from having frequently found, during the past summer, worms of three distinct sizes in the same orchard, and Mr. D. B. Wier of Lacon, Ills., had previously published the fact*, while a correspondent to the *Country Gentleman* of Albany, N. Y.† who says he has large experience with this borer, sent to the editors specimens of all three sizes, which he calls "this years, two and three year old worms." The individual from which I drew my figures, and which was taken from a crab apple tree, went into the pupa state on the 14th day of March and became a beetle on the 15th of April; but was doubtless forced into rapid development by being kept throughout the winter in a warm room.

Remedies.—From this brief sketch of our Round-headed borer, it becomes apparent that plugging the hole to keep him in, is on a par with locking the stable door to keep the horse in, after he is stolen; even supposing there were any philosophy in the plugging system, which there is not. The round smooth holes are an infalliable indication that the borer has left, while the plugging up of any other holes or cracks where the castings are seen, will not affect the intruder. This insect probably has some natural enemies belonging to its own great class, and some of our wood-peckers doubtless seek it out from its retreat and devour it; but its enemies are certainly not sufficiently under our control, and to grow healthy apple trees, we have to fight it artificially. Here again prevention will be found better than cure, and a stitch in time will not only save nine, but fully ninety-nine.

Experiments have amply proved that alkaline washes are repulsive to this insect, and the female beetle will not lay her eggs on trees protected by such washes. Keep the base of every tree in the orchard free from weeds and trash, and apply soap to them during the month of May, and they will not likely be troubled with borers. For this purpose soft soap or common bar soap can be used. The last is perhaps the most convenient and the newer and softer it is, the better. This borer confines himself almost entirely to the butt of the tree, though very rarely it is found in the crotch. It is therefore only necessary in soaping, to rub over the lower part of the trunk and the crotch, but it is a very good plan to lay a chunk of the soap in the principal crotch, so that it may be washed down by the rains. In case these precautions have been unheeded, and the borer is already at work, many of them may be killed by cutting through the bark at the upper end of their burrows, and gradually pouring hot water into the cuts so that it will soak through the castings and penetrate to the in-

**Prairie Farmer*, Chicago, April 20, 1867.

†*Country Gentleman*, Sept. 12, 1867.

sect. But even where the soap preventive is used in the month of May, it is always advisable to examine the trees in the fall, at which time the young worms that hatched through the summer may be generally detected and easily cut out without injury to the tree. Particular attention should also be paid to any tree that has been injured or sun-scalded, as such trees are most liable to be attacked. Mr. Wier who has had considerable experience with this insect, thus describes his method of doing this work, in the article already alluded to:

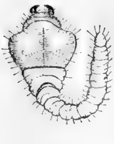
"I will suppose that I have a young orchard of any number of trees, say a thousand, the second season after planting, about the last of July, or during the first half of August, with a common hoe, I take all the weeds and other trash, and about an inch of soil, from the crown of the trees; then, any time from the first to the middle of September, with a pocket-knife, examine carefully the stem of each tree; the borer can readily be found by the refuse thrown out of the hole made on entering; this refuse of a borer, of the same season's growth, will be about the size of a pea, and, being of a glutinous nature, sticks around the mouth of the hole, and can rapidly be seen; older ones throw out coarser chips that fall to the ground. [As already shown these chips are not thrown out by the borer, but are forced out by swelling.] When one is found, take the knife and cut him out. If an orchard is carefully examined in this way each year, there need be but few, if any borers missed, and as they are more easily found the second fall of their growth, and can have done but little damage at that time, we would never receive any serious injury from them. Now, it is no great task to do this; a man will clear the litter and soil from around a thousand trees, in a day, and can take the borers out in another day. I will agree to do both jobs carefully in one day's time. A great undertaking is it not?"

He also has observed that some varieties of the apple-tree have a greater immunity from the attacks of this borer, than have others; on account of the young larva, when it is first hatched, being drowned out by the sap, but he does not mention any particular varieties other than those that are the "more vigorous and late growing."

THE FLAT-HEADED APPLE-TREE BORER—*Chrysobothr femorata*, Fabr.

(Coleoptera, Buprestidæ.)

[Fig. 15.]



[Fig. 16.]

This borer which is represented in the larva state at Figure 15, may at once be recognized by its anterior end being enormously enlarged and flattened. It is paler than the preceding, and makes an entirely different burrow. In consequence of its immensely broad and flattened head, it bores a hole of an oval shape and twice as wide as high. It never acquires much more than half the size of the other species, and is almost always found with its tail curled completely round towards the head. It lives but one year in the tree and

produces the beetle, represented at Figure 16, which is of a greenish black color with brassy lines and spots above, the underside appearing like burnished copper. This beetle flies by day instead of by night, and may often be found on different trees basking in the sunshine. It attacks not only the apple, but the soft maple, oak, peach, and is said to attack a variety of other forest trees; though, since the larvæ of the family (Buprestidæ) to which it belongs all bear a striking resemblance to each other, it is possible that this particular species has been accused of more than it deserves.

It is, however, but far too common in the Valley of the Mississippi, and along the Iron Mountain and Pacific railroads, it is even more common than the preceding species. Mr. G. Pauls, of Eureka. informs me that it has killed fifty apple trees for him, and Mr. Votaw, and many others in that neighborhood have suffered from it in like manner. It is also seriously affecting our soft maples by riddling them through and through, though it confines itself far the most part to the inner bark, causing peculiar black scars and holes in the trunk. Unless its destructive work is soon checked, it bids fair to impair the value of this tree for shade and ornamental parposes, as effectually as the Locust borers have done with the locust trees.

Remedies.—Dr. Fitch found that this borer was attacked by the larvæ of some parasitic fly, belonging probably to the *Chalcis* family, but it is greatly to be feared that this parasite is as yet unknown in the west. At all events this flat-headed fellow is far more common with us than with our eastern brethren. As this beetle makes its appearance during the months of May and June, and as the eggs are deposited on the trunk of the tree, as with the preceding species, the same method of cutting them out or scalding them can be applied in the one case as in the other; while the soap preventive is found to be equally effectual with this species as with the other. It must, however, be applied more generally over the tree, as they attack all parts of the trunk, and even the larger limbs.

THE PEACH BORER—*Ægeria exitiosa*, Say.

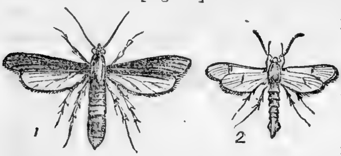
(Lepidoptera, Ægeridæ.)

This pernicious borer I find to be quite common throughout the State. It is withal an insect so familiar to the peach-grower, and its history has been so often given in current entomological works that I should let it go unnoticed, were it not for the numerous letters of inquiry about it that have been sent to me during the year. For a complete and lengthened history of it, I refer the reader to the first of Dr. Fitch's most excellent reports.

From the Round-headed Apple-tree borer, to which it bears some resemblance both in its mode of work and general appearance, it is

at once distinguished by having six scaly and ten fleshy legs. It works also more generally under the surface of the ground, and goes through its transformations within a year, though worms of two or three sizes may be found at almost any season. When full grown the worm spins for itself a follicle of silk, mixed with gum and excrement, and in due time issues as a moth. As it is not so well known in this last state, I annex (Fig. 17) figures of both male (2) and female (1) moths. As will be seen from these figures, the two sexes differ very materially from each other, the general color in both being glossy steel-blue. Some specimens which were received from Mr. W. S. Jewett, of Pevely, Jefferson county, commenced issuing as moths on the 20th of July, but I found empty follicles the latter part of May in trees which had been thoroughly wormed the year before, and from which the moths has consequently left at that early date. This borer likewise attacks the plum-tree, though singularly enough it causes no exudation of gum in this as it does in the peach tree.

[Fig. 17.]



REMEDIES.—I have had ample occasion to witness the effects of the mounding system during the summer, in several different orchards, and am fully convinced that it is the best practical method of preventing the attacks of this insect, and that it matters little whether ashes or simple earth be used for the mound. True, there are parties who claim (and among them Dr. Hull, of Alton, Ills.,) that the almost complete exemption from borers in mounded peach-orchards is due, not to any special effect produced by the mound, but to the general rarity of the insect. But I have found no general rarity of the insect, wherever I have been in our own State; but on the contrary, have with difficulty found a single tree in any orchard that was in anywise neglected, that did not contain borers; while I have found mounded trees entirely exempt. The following paragraph communicated to the *Western Rural* by Mr. B. Pullen, of Centralia, Illinois, touches on this point, and I can bear witness to the thrift and vigor of Mr. P.'s trees:

"As spring will soon be upon us I wish to add my testimony in favor of the "banking system," as a preventive against the attacks of the peach-borer. As to its efficacy there can be no doubt. I have practiced it four years with complete success. I would not advise its adoption until after the trees are four years old. During most of this period the bark is tender, and trees are liable to be entirely girdled by even a single worm. Safety lies only in personal examination and removal with the knife, in fall and spring (September and April). In April of the fourth year bank up to the hight of from ten to twelve inches, pressing the dirt firmly around the tree. A little dirt should be added each successive spring. It is not only a preventive but a great saving of labor."

As further testimony, and with a view to giving the method by which the trees may be mounded, I also insert the following communication from E. A. Thompson, of Hillside (near Cincinnati), Ohio, which appeared in the *Journal of Agriculture*, of Nov. 14, 1868:

"The mounding system was first practiced, so far as I know, by Isaac Bolmar, of Warren county, Ohio. I visited his orchards some years ago—acquainted myself with his system—and concluded to try it upon my orchard of 4,000 trees—then one year planted. I plant my trees in the fall, and in the spring following cut them back to six inches above the bud. The tree then instead of having one body has several—from three to six. The second summer I plow both ways, turning the furrows toward the trees. The men follow with shovels, throwing the loose soil around the tree to the heighth of about one foot. In the fall I cut the trees back, taking off about one-third of the year's growth. The next spring or summer I pursue the same method, raising the mound about one foot higher; cut back in the fall, and the third summer repeat the process, raising the mound another foot, which finishes the job. The mound will then be about three feet high at its apex and six feet in diameter at its base. The mounding need not be done in the summer, or at any particular season; it is just as well done in the fall when the hurry is over. The dirt is never taken away from the trees—in fact it cannot be removed without injury to the tree—for the young rootlets each year keep climbing up through this mound. I had occasion to remove one of these mounds a few days since and found it a mass of healthy roots.

Now for the benefits. First you have no trouble with grub or borer; he must have light and air, and the mound is too much for him; he comes out and that is the last of him. I have never wormed my trees, or hunted for the borer, and an orchard of healthier or thriftier trees cannot be found. It has been asserted that the borer will re-appear again near the top of the mound—but I am satisfied this is not the case; I have never thus far been able to find one. Second, the system imparts longevity to the tree. I saw a tree in Warren county treated in this manner *thirty* (30) years old, still healthy and bearing annual crops. Third, trees thus treated are not subject to disease. I have never had a case of *yellows* in my orchard. Fourth, the expense is trifling—one man can mound fifty trees per day. The system can be applied to old as well as young orchards; but if old trees are thus treated they should be first severely cut back, when they will make a growth of young wood."

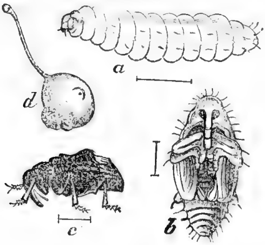
The application of soap does not appear to prevent the moth from depositing her eggs, as in the case of apple tree borers. Hot water is very efficient in killing the young borers, after the earth has been removed, and it should be applied copiously, and *hot* nigh unto the boiling point, for there is no danger of its injuring the tree. Those

who grow tobacco will also find it profitable to throw the stems around the butts of their trees, as there is good evidence of its being obnoxious to the moth.

THE PLUM CURCULIO—*Conotrachelus nenuphar*, Herbst.

(Coleoptera, Curculionidæ).

[Fig. 18.]



I regret to have to state that Missouri is none the less exempt from the ruinous work of this persistent "Little Turk," than are her sister States, though I have not heard of a single instance where they have been so numerous as they were last summer in Southern Illinois; for Parker Earle, of South Pass, captured 6,500 from 100 peach trees, during the first six days of May. In every locality which I have visited, this beetle is considered *the* enemy to stone fruit, and though so much has been written about it, I find it necessary to devote a few pages to its consideration, since some of the points in its natural history are not entirely and satisfactorily settled, even yet. There is in fact conflicting evidence from different authors, as to whether it is single or double brooded each year, and as to whether it hybernates principally in the perfect beetle state, above ground, or in the preparatory states, below ground; the very earliest accounts that we have of the Plum Curculio, in this country, differing on these points. Thus, it was believed by Dr. James Tilton, of Wilmington, Deleware, who wrote at the very beginning of the present century, and by Dr. Joel Burnett, of Southborough, and M. H. Simpson, of Saxonville, Massachusetts, who both wrote interesting articles on the subject, about fifty years afterwards; that it passed the winter in the larval or grub state, under ground, and Harris seems to have held the same opinion. But Dr. E. Sanborn, of Andover, Massachusetts, in some interesting articles published in 1849 and 1850, gave as his conviction that it hybernates in the beetle state above ground. Dr. Fitch, of New York, came to the conclusion that it is two-brooded, the second brood wintering in the larva state in the twigs of pear trees; while Dr. Trimble, of New Jersey, who devoted the greater part of a large

and expensive work to its consideration, decided that it is single-brooded, and that it hybernates in the beetle form above ground. Since the writings of Harris and Fitch, and since the publication of Dr. Trimble's work there have been other papers published on the subject. The first of these was a tolerably exhaustive article, by Mr. Walsh, which appeared in the *Practical Entomologist* (Vol. II, No. 7), in which he takes the grounds that the Curculio is single-brooded; though subsequently he came to the very different conclusion that it was double-brooded, (First Annual Rep., p. 67). In the summer of 1867 I spent between two and three weeks in Southern Illinois, during the height of the Curculio season, and closely watched its manœuverings. From the fact that there was a short period about the middle of July, when scarcely any could be caught from the trees, and that after a warm shower they were quite numerous, having evidently just come out of the ground,* I concluded that it was double-brooded and communicated to the *Prairie Farmer* of July 27th, 1867, the passage to that effect, under the signature of "V," which is quoted by Mr. Walsh (Rep., p. 67), as corroborative of its two-brooded character. Subsequent calculation induced me to change my mind, and I afterwards gave it as my opinion that there was but one main brood during the year, and that where a second generation was produced it was the exception, (Trans. Ills. State Hort. Soc., 1867, p. 113). Finally Dr. E. S. Hull, of Alton, Illinois, who has had vast personal experience with this insect, read a most valuable essay on the subject, before the meeting of the Alton (Ills.), Horticultural Society of March, 1868, in which he evidently concludes they are single-brooded, and that they pass the winter, for the most part, in the preparatory states, underground.

Now, why is it that persons who, it must be admitted, were all capable of correct observation, have differed so much on these most interesting points in the economy of our Plum Curculio? Is there any explanation of these contradictory statements? I think there is, and that the great difficulty in the study of this as well as of many other insects, lies in the fact that we are all too apt to generalize. We are too apt to draw distinct lines, and to create rules which never existed in nature—to suppose that if a few insects which we chance to watch are not single-brooded, therefore the species must of necessity be double-brooded. We forget that Curculios are not all hatched in one day, and from analogy, are very apt to underrate the duration of the life of the Curculio in the perfect beetle state. Besides, what was the exception one year may become the rule the year following. In breeding butterflies and moths, individuals hatched from one and the same batch of eggs on the same day, will frequently, some of them, perfect themselves and issue in the fall, while others will pass the winter in the imperfect state, and not issue till spring; and in the case

*I have often noticed, and the fact has been remarked by others, that insects which have been comparatively inactive for many days, in dry weather, fly freely after a warm shower, and it is possible that the increase of the Curculio after such rains is partly due to their flying in more vigorously from the surrounding woods.

of a green worm that is found on raspberry leaves, and which passes the winter under-ground, and develops into a four-winged fly (*Selandria rubi* of my manuscript) in the spring; I have known a difference of three months to occur between the issuing of the first and last individuals of the same brood, all the larvæ of which had entered the ground within three days. It is also a well recorded fact, both in this country and in Europe, that in 1868, owing, probably, to the unusual heat and drouth of the summer, very many insects which are well known to usually pass the winter in the imperfect state, perfected themselves in the fall, and in some instances produced a second brood of larvæ. Far be it from me to pronounce that there is no such thing as rule in nature, and that we cannot, therefore, generalize; I simply assert that we frequently draw our lines too rigidly, and endeavor to make the facts come within them, instead of loosening and allowing them to encompass the facts. It was thus that the Joint-worm fly was for so long a time suspected to be a parasite instead of the true culprit, because all the other species in the genus (*Eurytoma?*), to which it was supposed to belong, were known to be parasitic. For those who are not acquainted with the appearance of the Plum Curculio, in its different stages, I have prepared, at Figure 18, correct and magnified portraits of the full-grown *larva* (*a*); of the *pupa* (*b*) into which the larva is transformed within a little cavity underground, and of the perfect curculio (*c*).

With this prelude I will now give what I believe to be facts in its natural history, founded on my own observations of the past year, and on the observations of others. I firmly believe:

1—That Plum Curculios are a most unmitigated nuisance, and, though most beautiful objects under the microscope, the fruit-growers of the United States, if they had their own way about the matter, would wish them swept from off the face of the Earth, at the risk even of interfering with the "Harmony of Nature."

2—That they are more numerous in timbered regions than on the prairie.

3—That they *can* fly and *do* fly during the heat of the day, and that cotton bandages around the trunk, and all like contrivances to prevent their ascending the trees, are worse than useless, and a result only of ignorance of their economy.

4—That by its punctures it causes the dreaded peach-rot to spread, whenever that disease is prevalent, though it cannot possibly be the first cause of the disease. The peach-rot is now pretty generally acknowledged to be a contagious disease of a fungoid nature, and I believe that the spores of this fungus, "a million of which might be put upon the point of a stick whittled down to nothing," attach themselves more readily to fruit which has the skin abraded, and from which the gum issues, than to whole or unpunctured fruit. With this belief I made some effort to procure, for the benefit of my readers, a synopsis of the growth of this fungus; but, alas! I find that nothing

but confusion exists with regard to it. Upon applying to my friend, Dr. T. C. Hilgard, of St. Louis—a recognized authority on such subjects—he furnished me with the article which may be found in the *Journal of Agriculture* of January 16th, 1869. I most respectfully declined publishing it in these pages, knowing that the reader would not be likely to understand what was either too *profound* or too befogged for my own comprehension, and those who require a *synopsis* of this fungus, are referred to that article. Verily, we must conclude that Peach-rot is not yet much understood, if a more clear exposition of it cannot be given!

5—That they prefer smooth-skinned to rough skinned fruit.

6—That up to the present time the Miner and other varieties of the Chickasaw plum have been almost entirely exempt from their attacks, and that in the Columbia plum the young larvæ are usually "drowned out" before maturing.

7—That they deposit and mature alike in nectarines, plums, apricots, cherries and peaches; in black knot on plum trees, and in some kinds of apples, pears and quinces; and, according to Dr. Hull, they also deposit but do not mature in strawberries, gooseberries, grapes, and in the vigorous shoots of the peach tree.

8—That it is their normal habit to transform underground, though some few undergo their transformations in the fruit.

9—That the cherry, when infested, remains on the tree, with the exception of the English Morello, which matures and then separates from the stem; but that all other fruits, when containing larvæ, usually fall to the ground. In the larger fruits four or five larvæ may sometimes be found in a single specimen, and I have taken five full grown larvæ from a peach that had evidently fallen and laid on the ground for over a week.

10—That the greater portion of them pass the winter in the perfect beetle state, under the old bark of both forest and fruit trees, under shingles, logs, and in rubbish of all kinds, and especially in the underbrush of the woods.

11—That they are always most numerous in the early part of the season on the outside of those orchards that are surrounded with timber, and that they frequently shelter in apple-trees and other trees before the stone fruit forms.

12—That a certain portion of them also pass the winter underground, both in the larva and pupa states, at a depth, frequently of from 2 to 3 feet.

13—That those which hybernate as beetles, begin to leave their winter quarters and to enter our orchards, throughout central Missouri, during the first days of May, and commence to puncture the fruit about the middle of the same month—a little earlier or later according to the season—the fruit of the peach being at the time about the size of a small marble.

14—That those which hybernate underground continue to develop and to issue from the earth during the whole month of May.

15—That both males and females puncture the fruit for food, by gouging hemispherical holes, but that the female alone makes the well-known crescent-shaped mark (see Fig. 18, *d.*), as a nidus for her egg.

16—That the egg is deposited in the following manner, the whole process requiring about five minutes: Having taken a strong hold on the fruit (see Fig. 18, *d*), the female makes a minute cut with the jaws, which are at the end of her snout, just through the skin of the fruit, and then runs the snout under the skin to the depth of 1-16th of an inch, and moves it back and forth until the cavity is large enough to receive the egg it is to retain. She next changes her position, and drops an egg into the mouth of the cut; then, veering round again, she pushes it by means of her snout to the end of the passage, and afterwards cuts the crescent in front of the hole so as to undermine the egg and leave it in a sort of flap; her object apparently being to deaden this flap so as to prevent the growing fruit from crushing the egg, though Dr. Hull informs me that he has repeatedly removed the insect as soon as the egg was deposited and before the flap was made, and the egg hatched and the young penetrated the fruit in every instance.

17—That the egg is oval, of a pearl-white color, large enough to be seen with the naked eye, requires a temperature of at least 70° Fahr. to hatch it, and may be crushed with the finger-nail without injuring the fruit.

18—That the stock of eggs of the female consists of from 50 to 100; that she deposits from 5 to 10 a day, her activity varying with the temperature.

19—That the last of those curculios which hybernated in the imperfect state under-ground have not finished depositing till the end of June and beginning of July, or about the time that the new brood developed from the first laid eggs of the season, are beginning to issue from the ground; and that we thus have them in the month of June in every conceivable state of existence, from the egg to the perfect insect.

20—That the period of egg depositing thus extends over more than two months.

21—That all eggs deposited before the first of July generally develop and produce Curculios the same season, which issue from the ground during July, August and September and hybernate in the perfect state.

22—That most of those which hatch after the first of July, either fail to hatch, or the young larvæ die soon after hatching, owing perhaps to the more ripe and juicy state of the fruit, being less congenial to them; and that what few do mature, which hatch after this date,

undergo their transformations more slowly than the rest and pass the winter in the ground.

23—That the perfect Curculio while in the ground is soft and of a uniform red color, and that it remains in this state an indefinite period, dependent on the weather, usually preferring to issue after a warm rain.

24—That in a stiff clay soil a severe drought will kill many of them while in this last named condition, and that larvæ contained in stone fruits that fall upon naked ploughed ground where the sun can strike them, generally die.

This catalogue might be lengthened, but already embraces all the more important facts, and I think they sufficiently prove that the Curculio is single-brooded. There is, it is true, no particular reason why the earliest developed Curculios, or those which issue from the ground during the fore part of July, should not pair and deposit eggs again; other than it does not appear to be their nature to do so. Such an occurrence is by no means an isolated one in insect life, and aside from the fact that late fruit is almost entirely exempt from them, we have the experiments of Dr. Trimble which indicate that they have to pass through the winter before being able to reproduce their kind. The only other experiments that were ever made to prove the contrary hypothesis, are those detailed by Mr. Walsh, in his First Annual Report (p. 68), and, as may be seen from their perusal they prove nothing at all. To give them in his own words, I here quote them in full:

"EXPERIMENT 1ST.—On June 24th, I placed in a large glass vase, with moist sand at the bottom of it, a quantity of wild plums, every one of which I had previously ascertained to bear the crescent symbol of the 'little Turk.' During the three following weeks I added from day to day a number of plums, all of them bearing the same symbol, that had fallen from a tame plum-tree in my garden. The whole number of plums, as I subsequently ascertained, was 183, and the tame fruit probably formed about a fourth part of the whole. The first Curculio came out July 19th, and with the exception of July 21st and August 1st, there were more or less came out every day till August 4th, inclusive; after which day no more came out. The numbers coming out on each successive day were as follows, the very large number on July 25th having beeu probably caused by my wetting the sand on that morning rather copiously: 1, 18, 0, 3, 4, 2, 55, 8, 4, 3, 1, 2, 1, 0, 5, 4, 2. Total, 113. On examining the contents of the vase, November 29th, I found five dead and dried up Curculios among the plums, and among the sand sixteen dead and immature specimens, which had obviously failed to make their way up to the light of day, besides the remains of a good many individuals which had perished in the sand in the larva or pupa state, and were not counted. The Grand Total from 183 infested plums was, therefore, 134 Curculios in the beetle state, and an unknown number of larvæ and pupæ."

"EXPERIMENT 2d.—On July 27th, or eight days before the Curculios in the preceding experiment had ceased coming out, I placed in a vase, similar to the above, 243 plums, gathered promiscuously off some badly-infested wild plum-trees. From this lot no Curculios whatever came out till August 23d, and from that day, until September 14th, more or less came out daily, with the exception of five out of the 23 days, the numbers on the respective days being as follows: 3, 1, 2, 2, 2, 3, 2, 2, 5, 3, 1, 0, 5, 6, 3, 2, 0, 0, 0, 1, 0, 1, 1. Subsequently, on September 18th, there came ont 3, on September 24th, 1, and on September 28th, 1; after which no more made their appearance. Total, 50 Curculios from 243 plums, some stung and some not. On examiuing the contents of this vase on November 29th, I found a single dead Curculio among the plums, making a Grand Total of 51 Curculios bred from these plums. There were no specimens, either in

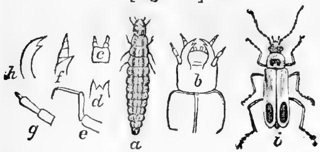
larva, pupa or beetle state, to be found among the sand in the vase on November 29th; which was, perhaps, due to the contents having kept much moister than those of the first vase, though on July 25th I had, as I thought, moistened the sand in the first vase quite sufficiently."

Now because there was an intermission of 19 days when no Curculios came out, Mr. Walsh arrives at once to the conclusion that there are two distinct broods, the second of which is, "of course" generated by the first. If the infected plums had been collected and placed in vases day by day, or if the curculios bred in the first experiment had been furnished with fresh plums and had actually paired and deposited again, the experiments would have been satisfactory; but as they stand, they seem to me, on the very face, to forbid the conclusions to which the experimenter arrived. In both these experiments the very result was obtained that might have been expected, for I have myself proved, that with favorable conditions the Curculio remains under ground about 3 weeks, and as there would naturally be none advanced beyond the full grown larva state, when first put into the vase, perfect Curculios could not possibly appear till they had had time to transform, or in other words, till about three weeks after the plums were placed in the vase. Thus from the plums placed in the vase on the 24th of June the first Curculios appeared on the 19th of July—25 days afterwards; while from those placed in the second vase on July 27th, the first Curculios appeared on the 23d of August—27 days afterwards. The interval also, of 19 days which elapsed between the issuing of the last Curculios in the first experiment and the first curculios in the last experiment, was exactly what should have been expected, since the plums were placed in the second vase eight days before the last curculios in the first vase had issued. Had the plums been placed in the second vase 10 days earlier or 10 days later, there would have been an intermission of 9 or 29 days accordingly, in their coming out, etc., etc. Moreover, a period of at least 50 days elapses between the deposition of an egg and the time required for that egg to develop into a Curculio and even on the supposition that the female commenced depositing the moment she left the ground, which is certainly not the case, the Curculios bred in the second vase could not possibly have been the progeny of any that appeared contemporaneously with those bred from the first vase.

Natural Remedies.—There is no very good evidence that any true parasites infest the Curculio, and though it was well known that ants attacked and killed the larvæ as they left the fruit to enter the ground, yet until the present year no other cannibals were known to attack it; but Mr. Walsh in his interesting account of a trip through Southern Illinois has shown that there are several cannibal insects which habitually prey upon it. From this account which was published in the American Entomologist—pp. 33-35—I condense the following facts.

THE PENNSYLVANIA SOLDIER-BEETLE (*Chauliognathus pennsylvanicus*, DeGeer).—This beetle which is represented at Figure 19, *i* is of a yellow color, marked with black. It is a common species and I have found it quite abundant in our own State on the flowers of the Golden-rod during the months of September and October. Its larva (Fig. 7, *a*) is one of the most effectual destroyers of the Curculio while the latter is above ground in the larva state. It attacks the Curculio grub within the fruit while it yet hangs on the tree, and also enters the fruit which falls to the ground, for the same purpose. In the summer of 1867 I found this same larva on an apple tree of the Early Harvest variety, the fruit of which contained Curculio larvæ from which I subsequently bred perfect Curculios. It is quite active in its movements, and the general color is smoky brown, with a velvety appearance, and for the benefit of those interested I subjoin the technical desription of it:

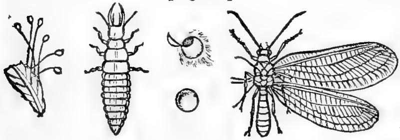
[Fig. 19*.]



CHAULIOGNATHUS PENNSYLVANICUS, DeGeer—*Larva*—Head shining rufous, with two black patches behind, transversely arranged; labrum retractile, dark colored, horny and deeply emarginate with a central tooth; maxillary palpi 4-jointed; labial palpi 2-jointed; antenna 3-jointed, the last joint very small; body rather flattened, of an opaque velvety-brown color above, with a somewhat darker subdorsal line, which is widened on the three thoracic segments; a very distinct lateral spiracle to every segment of the body except the anal one, making altogether eleven pairs of spiracles, all of them exactly alike, and in range with each other. Body beneath suddenly very pale brown, the dividing line between the darker and the paler shades of brown upon each segment being a semicircular curve, with its concavity upward; legs six; a moderate anal proleg; length 0.65 inch.

LACEWING LARVA.—The larvæ of our lacewing flies (*Chrysopa*) seem to have the same habit of attacking Curculio grubs above ground, and great numbers of them were found in the act last summer by Mr. E. Leming, of Cobden, Illinois. The particular species which those belonged to that were occupied in this good manner, has not yet been ascertained, but as they are all known to be cannibals it is possible that more than one species have this praiseworthy habit, though their general food consists of plant-lice. The lacewing flies are common all over the country, and may at once be recognized by their delicate green bodies, lace-like wings and by their brilliant golden eyes; but more especially by a peculiarly disagreeable odor which they are capable of emitting when handled. Our American lacewings, like those of Europe, are capable of emitting this odor, and those who have once experienced it require no description to recall it. One of these

[Fig. 20.]



a b c d

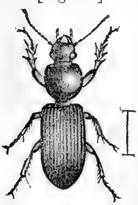
*Explanation of Figure 19—*h* the left upper jaw (*mandible*), *f* the left lower jaw (*maxil*), *c* the under lip (*labium*), *d* the upper lip (*labrum*), *g* the antenna, *e* one of the legs, *a* the larva natural size, *b* head and first segment of same enlarged.

flies, with the left wings cut off to save space, is represented at Figure 20 *d*, and a typical larva is represented in outline in the same figure at *b*. The female deposits her eggs upon different plants, attaching them at the extremity of a long and very slender foot-stalk (see Fig. 20, *a*). This filament is composed of a viscid matter which she discharges and which quickly hardens on exposure to the atmosphere. We see here, as everywhere else in Nature, an Allwise creative forethought, and a wonderful adaptation to a particular end, in the instinct which prompts, and the power which enables the female lacewing to thus deposit her eggs; for the newly hatched larvæ are so exceedingly voracious that the first hatched would devour the eggs which yet remained unhatched, if they could but reach them.

The larvæ when full-grown spin perfectly round white cocoons (Fig. 20, *c*), by means of a spinneret with which they are furnished at the extremity of the body, and they attach them with threads of loose silk to the underside of fences and in other sheltered situations. These cocoons are of an extraordinary small size compared with the larva which spins them, or with the perfect insect which escapes from them, as may be readily seen by referring to the above figures which bear the relative proportions. After completing the cocoon, I think the larva partly cuts a circle at one side severing the fibers sufficiently to enable their ready separation; for in issuing, the pupa pushes open a small lid, which is cut perfectly smooth, and just spirally enough to allow it to hang at one end as on a hinge. I have also noticed another fact, which, so far as I am aware, has not been recorded by any previous writer, which is, that the insect issues from this cocoon in an active sub-imago state, from which after a few hours the winged fly emerges, leaving behind it a fine silvery-white transparent skin.

THE SUBANGULAR GROUND BEETLE—(*Aspidiglossa subangulata*, Chaud.)—This small polished black beetle which is represented enlarged at Figure 21, the hair line at the side showing the natural size, also, in all probability serves us a good turn in helping to diminish the numbers of the Curculio, for Mr. Walsh found him in a peach that had contained Curculio grubs, and as the great family of beetles (*Carabus*) to which he belongs are all cannibals so far as is known, and as he was therefore evidently not inside the peach for the fruit itself, he is to be strongly suspected of being a Curculio hunter. To adopt Shakespeare's mode of reasoning:

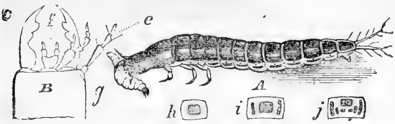
[Fig. 21.]



"Who finds the heifer dead, and bleeding fresh,
And sees fast by a butcher with an axe,
But will suspect 'twas he that made the slaughter?"

The Curculio is not even safe from the attacks of cannibals when underground, for the larva which is represented of the natural size at Figure 22, *A*, seeks it in its hiding place and mercilessly devours it. This larva is of a shining brown-black color above, and dull whitish beneath, and I subjoin herewith the technical description:

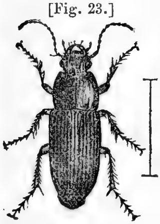
[Fig. 22.*]



Shining brown-black and horny above; thorax immaculate above; sutures and sides of the abdominal dorsum, and all beneath, except the head, pale dull greenish white; a narrow, horny, elongate, abbreviated lateral dark stripe on the dorsum of each of the abdominal joints (4—12); joints 4—10 beneath, each with seven pale-brown horny spots, namely, a large subquadrate spot followed by two small dots in the middle, an elongate spot on each side, and between that and the two medial small dots a second elongate spot, only half the length and breadth of the lateral one (Fig. 22, *j*); joint 11 beneath has only the medial subquadrate spot and the lateral elongate one (Fig. 22, *i*); and joint 12 beneath has nothing but the subquadrate spot (Fig. 22, *h*); legs six, of a pale rufous color; the usual elongate carabidous proleg on joint 12, and on each side of its tip an elongate exarticulate cercus, garnished with a few hairs; antennæ four-jointed; labial palpi two-jointed; maxillary palpi four-jointed. Length 1.25 inch.

This larva has not yet been bred to the perfect state, but belongs undoubtedly to some one of the Ground-beetles, and not improbably to the Pennsylvania Ground-beetle, (*Harpalus pennsylvanicus*, DeGeer), a dull black species represented at Figure 23. All these Ground-beetles are our friends however, and should always be cherished and not crushed, as they are very apt to be from their habit of crawling and living on the ground. It is safe to infer, that all beetles approaching the annexed form, with active movements, and generally dull colors, which are observed running over the ground, are friends, and should therefore be saved.

[Fig. 23.]



Hogs.—Before leaving the subject of natural remedies, I feel in duty bound to say a few words in favor of hogs as Curculio destroyers. Abundant proof might be adduced of their utility in an orchard, especially during the fruit season, but I will mention only the case of Messrs. Winters Bros., of Du Quoin, Ills. These gentlemen, for the past five years, have kept a large drove of hogs in their extensive peach orchard, and have been remarkably exempt from the attacks of the Little Turk. While at their place last fall, I noticed that all the trees were banked up with earth to the height of over a foot, which prevented the hogs from injuring the trunks. They have never had occasion to shake their trees, and consider one hog to the acre sufficient to devour all the fallen fruit, the hogs being fed only during the winter. The efficacy of this hog remedy depends a great deal on how much one's orchard is isolated from those of others, for it is very evi-

* Explanation of Figure 22.—*B* represents the under side of the head, showing at *c* the upper jaw (*mandible*), at *g* the lower jaw (*maxil*), with its fonr-jointed feelers (*palpi*), at *f* the lower lip (*labium*), with its two-jointed feelers (*palpi*), and at *e* the *antenna*.

dent that it will avail but little for one person to destroy all his Curculio while his neighbors are breeding them by thousands, so that they can fly in upon him another year. They would also be of but little service in the case of the cherry, as it remains on the tree when stung. Poultry will be found valuable in an orchard as they also devour the grubs which fall with the fruit.

ARTIFICIAL REMEDIES.—Of the hundreds of patent nostrums, and of the dozens of washes and solutions that have been recommended as Curculio preventives or destroyers, there is scarcely one which is worth the time required to speak of it. Air-slacked lime thrown on the trees after the fruit is formed, is effectual in a certain measure, for though it does not deter the female from depositing her eggs, yet so long as the weather is wet, its caustic properties seem to be imparted to the water and enter the cavity and destroy the egg. But it has no good effect in dry weather. An article went the rounds of the papers last Summer, to the effect that Mr. P. E. Rust, of Covington, Ky., had tried burning tobacco stems with *perfect success!* But a letter of inquiry which I addressed to that gentleman was never answered, although it contained the requisite 3-cent postage stamp, and the tobacco remedy may be placed by the side of the Gas-tar and Coal-tar remedies, which have proved utterly useless. After all, as Dr. Hull, suggests, the successes, so reported, of these remedies, take their origin from insufficient experiment, by persons who are little aware of the casualties to which the Curculio is subject, and who, if they happen to get fruit after applying some particular mixture, immediately jump to the conclusion that it was on account of such mixture.

It may therefore be laid down as a maxim, that the only effectual and scientific mode of fighting the Curculio, aside from that of picking up the fallen fruit, is by taking advantage of its peculiar instinct which on approach of danger prompts it to fall; or in other words to catch it by jarring the tree. The most effectual method of doing this on a large scale is by means of Dr. Hull's "Curculio catcher," and I give a description of it in the Doctor's own words:

"To make a curculio catcher we first obtain a light wheel, not to exceed three feet in diameter, the axletree of which should be about ten inches long. We next construct a pair of handles, similar to those of a wheelbarrow, but much more depressed at the point designed to receive the bearings of the axletree, and extending forward of the wheel just far enough to admit a crossbeam to connect the handles at this point; one-and-a-half inches in the rear of the wheel a second cross beam is framed into the handles, and eighteen to twenty-four inches further back, a third. The two last named cross-beams have framed to their under-sides a fourth piece, centrally, between the handles, and pointing in the direction of the wheel. To the handles and to the three last named pieces, the arms or ribs to support the canvass are to be fastened. To the front part of the beam connecting the handles in front of the wheel, the ram is attached, this should be covered with

leather stuffed with furniture moss, a dozen or more thicknesses of old hat, leather or other substance, being careful to use no more than necessary to protect the tree from bruising. Ascertain the elevation the handles should have in driving, and support them in that position. We now put in place the stretchers or arms, six for each side, which are to receive and support the canvas. We put the front arms in position. These extend back to near the centre of the wheel on each side, and in front of the wheel (for large machines) say six feet, and are far enough apart to receive the largest tree between them on which it is intended to operate. The remaining arms are supported on the handles, and fastened to them and to the two cross and parallel pieces in the rear of the wheel. These are so placed as to divide the space at their outer ends equally between them and the first mentioned stretchers and fastened to the ends of the handles. Next we have ready a strip of half-inch board two an a half wide. One end of this is secured to the forward end of one of the front arms, and in like manner to all the others on one side of the machine, and fastened to the handles. Both sides are made alike. The office of these strips is to hold the outside ends of the arms in position; they also hold the front arms from closing. These outside strips also receive the outside edge of the canvas, which is fastened to them as well as the several arm supports.

"It will be seen that the wheel is nearly in the center of the machine. To cover the opening at this point, a frame is raised over it, which is also covered with canvas. The arms, or stretchers, are so curved that the motion of the machine, in moving from one tree to another, should bring everything falling on the canvas to depressed points, one on each side of the wheel, where openings are made into funnels emptying into pockets or bags, for the reception of insects and fallen fruit. The whole machine should not exceed ten or eleven feet in breadth, by twelve or thirteen in length. These are for large orchard trees; smaller ones could be protected with a much smaller machine. If the frame work has been properly balanced, the machine will require but little lifting, and will be nearly propelled by its own weight.

"This curculio catcher, or machine, is run against the tree three or four times, with sufficient force to impart a decided jarring motion to all its parts. The operator then backs far enough to bring the machine to the center of the space between the rows, turns round and in like manner butts the tree in the opposite row. In this way a man may operate on three hundred trees per hour."

To run this machine successfully three things are necessary: 1st, that the land be decently clean, and not overgrown with rank weeds; 2d, that the orchard be sufficiently large to pay the interest on the prime cost of the machine—about $30; 3d, that the trees have a clean trunk of some three or four feet. I find various modifications of this machine, both in our own State and in Southern Illinois, and in some

instances they have been abandoned entirely on account of the injury caused to the trees from the repeated blows given to the trunk. In small orchards it will be found most profitable to drive a spike into the trunk of each tree and to use two sheets stretched on frames, which can both be dragged or carried and placed in position by one man, while a second person gently taps the iron spike with a mallet. To bring the Curculio down, it requires a light, *sudden* tap which jars, rather than a blow which shakes, and if the frames are each made so as to fold in the middle, it will facilitate disposing of those which fall upon it.

In conclusion, the intelligent fruit-grower can draw many a lesson from this account of the Curculio—already somewhat lengthy. Thus in planting a new orchard with timber surrounding, the less valuable varieties should be planted on the outside, and as the little rascals congregate on them from the neighboring woods in the early part of the season, they should be fought persistently. It will also pay to thin out all fruit that is known to contain grubs, and that is within easy reach; while wherever it is practicable all rubbish and underbrush should be burnt during the winter, whereby many, yes *very many* of them will be destroyed in their winter quarters. As a proof of the value of this measure when it is feasible, I will state that while the peach crop of Southern Illinois was almost an entire failure in 1868, Messrs. Knowles & Co., who have 70 acres of peach orchard 1¼ miles N. W. of Makanda, shipped over 9000 boxes. Though they had a few hogs in the orchard, there were not enough to do any material good, and they think they owe their crop to the fact of having cleared and burnt 100 acres surrounding the orchard, in the early spring of that year; for in 1867 the Curculios had been very bad with them. Judge Kimble, who lives 4 miles N. E. of Cobden, also had a good crop free from their marks, which he attributes to having burnt around the orchard in the spring of the year.

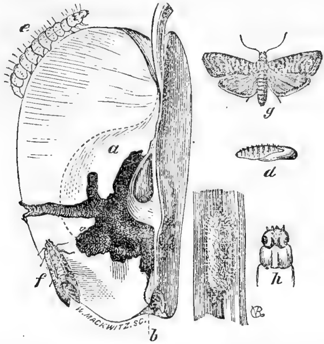
THE CODLING MOTH OR APPLE-WORM—*Carpocapsa pomonella*, Linn.

(Lepidoptera, Tortricidæ.)

The Apple-worm, I find to be quite common all over the State, as it is in almost all parts of the civilized world where apples are grown. Dr. Trimble has devoted page after page to the consideration of this little pest, and yet its whole history and the means of preventing its insidious work may be given in a very few lines. It was originally a denizen of the Old World, but was introduced into this country about the beginning of the present century. The following figure represents it in all its states, and gives at a glance its natural history: *a* represents a section of an apple which has been attacked by the worm, showing

the burrowings and channel of exit to the left; *b*, the point at which the egg was laid and at which the young worm entered; *e*, the full

[Fig. 24]



grown worm; *h*, its head and first segment magnified; *i*, the cocoon which it spins; *d*, the chrysalis to which it changes; *f*, the moth which escapes from the chrysalis, as it appears when at rest; *g*, the same with wings expanded. The worm when young is whitish, with usually an entirely black head and a black shield on the top of the first segment. When full grown it acquires a flesh-colored or pinkish tint, especially on the back, and the head and top of first segment become more brown, being usually marked as at Figure 24 *h*. It is sparsely covered with very minute hairs which take their rise from minute elevated points, of which there are eight on each segment. The cocoon is invariably of a pure white color on the inside, but is disguised on the outside by being covered with minute fragments of whatever substance the worm happens to spin to. The chrysalis is yellowish brown, with rows of minute teeth on its back, by the aid of which it is enabled to partly push itself out of its cocoon, when its time to issue as a moth arrives. The moth is a most beautiful object; yet, as has been well remarked by an anonymous writer,* from its habits not being known it is seldom seen in this state, and the apple-grower as a rule, "knows no more than the man in the moon to what cause he is indebted for the basketfuls of worm-eaten windfalls in the stillest weather." Its fore wings are marked with alternate, irregular transverse wavy streaks of ash-gray and brown, and have on the inner hind angle a large tawny brown spot, with streaks of bright bronze color or gold.

The apple is, so to speak, our democratic fruit, and while stone fruit is grown but in certain regions, this is cultivated all over the country. The Codling moth is then even more injurious than the Curculio. Unlike the Curculio, it is mostly two-brooded, the second brood of worms hybernating in the larval state, inclosed in their snug

* Entomological Magazine, London, Vol. I, p. 144.

little silken houses, and ensconced under some fragment of bark or other shelter. The same temperature which causes our apple trees to burst their beauteous blossoms, releases the Codling moth from its pupal tomb, and though its wings are at first damp with the imprint of the great Stereotyping Establishment of the Almighty, they soon dry and expand under the genial spring-day sun, and enable each to seek its companion. The moths soon pair, and the female flits from blossom to blossom, deftly depositing in the calyx of each a tiny yellow egg. As the fruit matures, the worm develops. In thirty-three days, under favorable circumstances, it has become full-fed; when, leaving the apple, it spins up in some crevice, changes to chrysalis in three days, and issues two weeks afterwards as moth, ready to deposit again, though not always in the favorite calyx this time, as I have found the young worm frequently entering from the side. Thus the young brood of Codling moths appear at the same time as the young Curculios, the difference being that instead of living on through fall and winter, as do the latter, they deposit their eggs and die, it being the progeny from these eggs which continues the race the ensuing year. Though two apples side by side may, the one be maturing a Curculio, the other a Codling moth, the larva of the latter can always be distinguished from the former by having six horny legs near the head, eight fleshy legs in the middle of the body, and two at the caudal extremity, while the Curculio larva hasn't the first trace of either.

In latitude 38° the moths make their appearance about the first of May, and the first worms begin to leave the apples from the 5th to the 10th of June and become moths again by the fore part of July. While some of the first worms are leaving the apples, others are but just hatched from later deposited eggs, and thus the two broods run into each other; but the second brood of worms (the progeny of the moths which hatch out after the first of July), invariably passes the winter in the worm or larval state, either within the apple after it is plucked, or within the cocoon. I have had them spin up as early as the latter part of August, and at different dates subsequently till the middle of November, and in every instance, whether they spun up early or late in the year, they remained in the larval state till the middle of April, when they all changed to chrysalids within a few days of each other. Furthermore, they not only remain in the larval state, but in many instances where I have had them in a warm room, they have been *active* throughout the winter, and would always fasten up the cuts made in their cocoons, even where the operation was performed five and six times on the same individual. These active worms perfected themselves in the spring as well as those which had not been disturbed, and this fact would indicate that the torpid or dormant state, so called, is not essential to the well being or the prolongation of life of some insects.

Though the Codling moth prefers the apple to the pear, it nevertheless breeds freely in the latter fruit, for I have myself raised the

moth from pear-boring larvæ, and the fact was recorded many years, ago by the German entomologist, Kollar. It also inhabits the fruit of the crab-apple and quince, and is not even confined to pip-fruit, for Dr. T. C. Hilgard, of St. Louis, bred a specimen, now in my cabinet, from the sweetish pulp of a species of screw-bean (*Strombocarpa monoica*) which grows in pods, and which was obtained from the Rocky Mountains, while Mr. Wm. Saunders, of London, Ontario, Canada, has also found it attacking the plum in his vicinity.* This is entirely a new trait in the history of our Codling moth, and is another evidence of the manner in which certain individuals of a species may branch off from the old beaten track of their ancestors. This change of food sometimes produces a change in the insects themselves, and it would not be at all surprising, if this plum-feeding sect of the Codling moth, should in time show variations from the normal pip-fruit feeding type. As Mr. Saunders is a well known entomologist, it is not likely that he has been mistaken in the identification of the species, for the only other worm of this character which is known to attack the plum in America, is the larva of Mr. Walsh's Plum moth (*Semasia prunivora*) which is a very much smaller insect than the Codling moth. Mr. Saunders says that his plum crop suffered considerably from this cause and that the operation appeared to be performed by the second brood, the plums falling much later than those stung by the Curculio—remaining in fact on the tree till nearly ripe. I do not think that this insect has yet acquired an appetite for the plum in the States. As a general rule, there is but a single worm in each apple, but two are sometimes found in one and the same fruit.

Remedies.—Though with some varieties of the apple, the fruit remains on the tree till after the worm has left it, yet by far the greater portion of the infested fruit falls, prematurely with the worm, to the ground; hence much can be done toward diminishing the numbers of this little pest by picking up and destroying the fallen fruit as soon as it touches the ground. For this purpose, hogs will again be found quite valuable, when circumstances allow of their being turned into the orchard. Abundant testimony might be given to prove this, but I make room only for the following from Mr. Suel Foster, of Muscatine, Iowa, whom I know to be abundantly capable of forming a proper judgment:

"I have twenty-four acres of my orchards seeded to clover, and last year I turned the hogs in. I now observe that where the hogs ran last year, the apples have not one-fourth the worms that they have on other trees. I this year turned the hogs into my oldest (home) orchard.†"

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* Report of the Commissioner of Agriculture and Arts, of the Province of Ontario, for the year 1868, page 200.

† Transactions Illinois State Horticultural Society, 1867, page 213.

Mr. Huron Burt, of Williamsburg, Mr. F. R. Allen, of Allenton and Mr. Varnum, of Sulphur Springs, have also, each of them, testified to me as to the good effects obtained from allowing hogs the run of their orchards.

There is, however, a more infallible remedy, and one which is always practicable. It is that of entrapping the worms. This can be done by hanging an old cloth in the crotches of the tree, or by what is known as Dr. Trimble's hay-band system, which consists of twisting a hay-band twice or thrice around the trunk of the tree. To make this system perfectly effectual, I lay down the following as rules: 1*st*, *the hay-band should be placed around the tree by the first of June, and kept on till every apple is off the tree*; 2*d*, *it should be pushed up or down, and the worms and chrysalids crushed that were under it, every week, or at the very latest, every two weeks*; 3*d*, *the trunk of the tree should be kept free from old rough bark, so as to give the worms no other place of shelter, and*, 4*th*, *the ground itself should be kept clean from weeds and rubbish.* But, as already stated on a previous page, many of the worms of the second brood yet remain in the apples even after they are gathered for the market. These wormy apples are barrelled up with the sound ones, and stored away in the cellar or in the barn. From them the worms continue to issue, and they generally find plenty of convenient corners about the barrels in which to form their cocoons. Hundreds of these cocoons may sometimes be found around a single barrel, and it therefore becomes obvious that, no matter how thoroughly the hay-band system had been carried out during the summer, there would yet remain a sufficiency in such situations to abundantly continue the species another year. And when we consider that every female moth which escapes in the spring, lays from two to three hundred eggs, and thus spoils so many apples, the practical importance of thoroughly examining, in the spring of the year, all barrels or other vessels in which apples have been stored becomes at once apparent. It should, therefore, also be made a rule to destroy all the cocoons which are found on such barrels or vessels either by burning them up or by immersing them in scalding hot water.

Now, there is nothing in these rules but can be performed at little trouble and expense. Their execution must henceforth be considered a part of apple-growing. Let every apple-grower in Missouri carry them out strictly, and see that his neighbors do likewise, and fine, smooth, unblemished fruit will be your reward!

The philosophy of the hay-band system is simply that the worms, in quitting the fruit, whether while it is on the tree or on the ground, in their search for a cozy nook, in which to spin up, find the shelter given by the hay-band just the thing, and in ninety-nine cases out of a hundred, they will accept of the lure, if no other more enticing be in their way. I have thoroughly tested this remedy the past summer, and have found it far more effectual than I had anticipated, wherever

the above rules were recognized. Under two hay-bands which were kept around a single old isolated tree, through the months of June, July and August, I found every week of the last two months an average of fifty cocoons.

I have often smiled in my journeyings through the State, to see the grin of incredulity spread over the face of some unsophisticated farmer as I recounted the natural history of this Codling moth, and urged the application of the hay-band. Magic spell or fairy tale could not more thoroughly have astounded some of them than the unmasking of this tiny enemy and the revealing of the proper preventive.

The burning of fires has been recommended, under the supposition that the moths will fly into them and get destroyed. I have no faith whatever in the process, so far as regards this particular species, for though it is true that the moths fly and deposit their eggs in the evening, I do not believe they are attracted to the light, as are some others, for I have never been able to thus attract any myself.

CUT-WORMS.

(Lepidoptera Noctuidæ.)

THE NATURAL HISTORY OF TWELVE DISTINCT SPECIES.

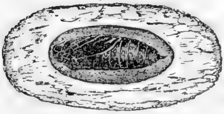
There are several different kinds of insects that are known by the popular name of cut-worm. Thus, the White grub, or larva of the common May beetle (*Lachnosterna quercina*, Knoch), and the different species of wire-worms, the larvæ of our Click beetles (*Elater* family) are all called cut-worms in some part or other of the United States. But I shall confine the term to those caterpillars, which, for the most part, have the habit of hiding just under the surface of the earth during the day, and feeding either on the roots, stems or leaves of plants during the night.

Most of these caterpillars have the very destructive habit of cutting, or entirely severing the plant on which they feed, just above or below the ground. On this account they have received the name of *Cut*-worms, and not because when cut in two, each end will reproduce itself as some people have supposed; for although some polyps and other animals belonging to the great class RADIATA in the animal kingdom, have this curious power of multiplying by division, it is not possessed by any insect, and after having mutilated one of these cut-worms, the farmer need never fear that he has thereby increased, instead of having decreased their number. From this habit of cutting, they prove a far greater nuisance than if they were to satisfy their appetites in an honest manner. In the latter case we might feel like letting them go their way in peace, but as with the Baltimore oriole, which abrades and ruins a hundred grapes where it would require one for food, we feel vexed at such wanton destruction of our products, and would gladly rid ourselves of such nuisances.

These caterpillars are called surface caterpillars in England, in which country, as well as on the continent of Europe, they have long been known to do great damage to vegetables, and especially to the cabbage, mangel-wurzel and turnip. There are many different species and they vary in size and detail of markings; but all of them are smooth, naked and greasy-looking worms of some shade of green, gray, brown or black, with a polished, scaly head, and a shield of the same color on the top of the first and last segments; while most of them have several minute shiny spots on the other segments, each spot giving rise to a minute stiff hair. They also have the habit of curling up in a ball when disturbed, as shown at Figure 2, in Plate 1. They produce moths of sombre colors which are known as Owlet or Rustic moths, and the species that have so far been bred in this country, belong to one or other of the four genera, *Agrotis*, *Hadena*, *Mamestra* or *Celæna*. These moths fly, for the most part by night, though some few of them may be seen flying by day, especially in cloudy weather. They frequently, even in large cities, rush into a room, attracted by the light of gas or candle, into which they heedlessly plunge and singe themselves. They rest with the wings closed more or less flatly over the body, the upper ones entirely covering the lower ones, and these upper wings always have two, more or less distinctly marked spots, the one round, the other kidney-shaped.

The natural history of most of these cut-worms may be thus briefly given. The parent moth attaches her eggs to some substance near the ground, or deposits them on plants, mostly during the latter part of summer, though occasionally in the spring of the year. Those which are deposited during late summer, hatch early in the fall, and the young worms, crawling into the ground feed upon the tender roots and shoots of herbaceous plants. At this time of the year, the worms being small and their food plentiful, the damage they do is seldom noticed. On the approach of winter they are usually about two-thirds grown, when they descend deeper into the ground, and, curling themselves up, remain in a torpid state till the following spring. When spring returns, they are quite ravenous, and their cutting propensities having fully developed, they ascend to the surface and attack the first green succulent vegetation that comes in their way. When once full grown they descend deeper into the earth, and form for themselves oval chambers, in which they change to chrysalids, as shown in the annexed cut (Fig. 25). In this state they remain from two to four weeks, and finally come forth as moths, during the months of June, July and August, the chrysalis skin, being in most cases so thin, that it is impossible to preserve it. These moths in time lay eggs, and their progeny goes through the same cycle of changes. Some species, however, as I shall presently show, are most likely two-brooded, while others pass through the winter in the chrysalis state.

[Fig. 25].



Dr. Fitch states that he had great difficulty in breeding these cut-worms to the perfect moths, "as the worms on finding themselves imprisoned, hurriedly crawl around and around the inner side of their prison, night after night, until they literally travel themselves to death." Consequently the natural history of but one or two of them has hitherto been known. I have found, however, that by giving them the proper conditions they are not so very difficult to breed, and after giving some account of a certain class of cut-worms which have the habit of climbing up trees, I will briefly describe those species which I have traced through their transformations, so that they may be readily recognized, and afterwards suggest the proper remedies.

CLIMBING CUT-WORMS.

Orchardists in spring frequently find the hearts of their fruit buds —on young trees especially—entirely eaten out and destroyed, and this circumstance is attributed to various causes, winged insects, beetles, slugs for instance; or even to late frosts, unsuitable climate, etc. Never have cut-worms received the blame, all of which should be ascribed to them, for the game hold of many species on a sandy soil in early spring, is the fruit tree. This is a very important fact to fruit raisers, and let those who have essayed to grow the dwarf apple and pear, on a sandy soil, and have become discouraged, as many have, from finding their trees affected each year in this way, take hope; for knowing the cause, they may now easily prevent it.

These climbing cut-worms will crawl up a tree eight or ten feet high, and seem to like equally well the leaves of the pear, apple and grape.

They work during the night, always descending just under the surface of the earth again at early dawn, which accounts for their never having been noticed in this their work of destruction in former years. They seldom descend the tree as they ascend it, by crawling, but drop from the bud or leaf on which they have been feeding; and it is quite interesting to watch one at early morn when it has become full fed and the tender skin seems ready to burst from repletion, and see it prepare by a certain twist of the body for the fall. This fact also accounts for trees on hard, tenacious soil, being comparatively exempt from them, as their instinct doubtless serves them a good turn either in preventing them from ascending or by leading the parent moth to deposit her eggs by preference on a light soil.

These facts were published in the *Prairie Farmer* of June 2, 1866, accompanied with descriptions by myself of three of the worms that were found to have this habit; and the observations were made on Mr. J. W. Cochran's farm at Calumet, Illinois. In speaking of these same climbing cut-worms, in the same article Mr. Cochran says:

"They destroy low branched fruit trees of all kinds, except the peach, feeding on the fruit buds first, the wood buds as a second

choice, and preferring them to all other things, tender grape buds and shoots (to which they are also partial) not excepted—the miller always preferring to lay her eggs near the hill or mound over the roots of the trees in the orchard; and if, as is many times the case, the trees have a spring dressing of lime or ashes with the view of preventing the May beetles' operations, this will be selected with unerring instinct by the miller, thus giving her larvæ a fine warm bed to cover themselves up in during the day from the observations of their enemies. They will leave potatoes, peas and all other young green things for the buds of the apple and the pear. The long, naked young trees of the orchard are almost exempt from their voracious attacks, but I have found them about midnight, of a dark and damp night well up in the limbs of these. The habit of the dwarf apple and pear tree however just suits their nature, and much of the complaint of those people who can not make these trees thrive on a sandy soil, has its source and foundation here, though apparently utterly unknown to the orchardist. There is no known remedy; salt has no properties repulsive to them, they burrow in it equally as quick as in lime or ashes. Tobacco, soap and other diluted washes do not even provoke them; but a tin tube 6 inches in length, opened on one side and closed around the base of the tree, fitting close and entering at the lower end an inch into the earth, is what the lawyers would term an effectual estopper to further proceedings.

"If the dwarf tree branches so low from the ground as not to leave 6 inches clear of trunk between the limbs and ground, the limbs must be sacrificed to save the tree—as in two nights four or five of these pests will fully and effectually strip a four or five year old dwarf of every fruit and wood bud, and often when the tree is green, utterly denude it of its foliage. I look upon them as an enemy to the orchard more fatal than the canker worm when left to themselves, but fortunately for mankind more surely headed off."

Harris gives us the earliest intimation of this climbing character in these worms, on page 450 of his work, where he says, that "in the summer of 1851, an agricultural newspaper contained an account of certain naked caterpillars, that came out of the ground in the night, and crawling up the trunks of fruit-trees, devoured the leaves, and returned to conceal themselves in the ground before morning." But until the above article, from which I have quoted, was published, the fact was not generally known and none of the species had been identified.

They seem to prefer the apple, pear and grape-vine, though they also attack the blackberry, raspberry, currant, and even rose-bushes and ornamental trees. Nor do they confine themselves to dwarf trees, as the following extract from a letter by John Townley, of Marquette Co., Wis., to the *Practical Entomologist* for March, 1867, abundantly proves.

"During the last two years at least, young apple-trees in this locality have been much injured by having their buds destroyed. My observations last spring led me to conclude, that a worm very like the cut-worm, and having the same habit of hiding just beneath the surface of the soil during the day and feeding by night, was the cause of the mischief. * * * * * *

"Soon after snow had gone in 1865, I pruned a lot of apple-trees then four years planted. The wood at the time seemed alive and sound. When older trees were coming into leaf, these remained almost destitute of foliage; and on examining them, it was found, that most of the buds, especially those on shoots formed the preceding year, were gone—removed as clean as if they had been picked out with a point of a knife. The bark in small patches near the ends of some of the shoots had also been eaten or chipped off. As many small birds had been seen about the trees, the conclusion was arrived at that they had probably eaten the buds. In the fall, mounds of earth were thrown up around the stems of these trees, and of another lot two years planted. These mounds were being leveled on the 6th of May last; and soon after commencing the work, several large cut-worms like grubs were noticed. This, coupled with the fact, that in the preceding spring, I had caught a worm like these in the very act of eating out a bud high up the stem of a young Catalpa, around which I had thrown a blanket the evening before, to shield it from frost, induced me to suspect that they and not the birds destroyed the buds. This led to an examination of the untouched mounds; and in the soil immediately surrounding the stem of each tree, I found from about five to ten of these worms. Twenty-three were taken from the soil around a plant of the Rome Beauty apple. * * * On a warm dewy night about the middle of the month, I took a lamp and suddenly jarred several of the trees; when some of these worms came tumbling to the ground. The evidence against them would have been more conclusive, if I had searched the branches and found them there and at work. That however, I omitted to do. I have had fruit trees planted here sixteen years, but never had the buds destroyed so as to attract my attention before the last two years; nor have I had any complaints from my neighbors on this point, except during that time. Orchards are not very common here, but in three others in this town, I know young trees have been injured as in my own during the last two years. * * * I grow no dwarf apples; mine are all standard trees worked on the ordinary apple stock."

Mr. Cochran also found them last spring, up among the highest branches of his standard as well as his dwarf trees.

The subject is all important to the orchardist, and to those especially who have young and newly planted trees on a light soil; for there are many who have had their trees injured by the buds being devoured in this manner, who never dreamed of preventing such an

occurrence, for the reason that the mischief was attributed to birds. Thus our Quail, Purple-finch, and many other birds, have too often unjustly received the execrations of the culturist, which that evil genius the cut-worm, alone deserved. To understand an enemy's foible is to have conquered, and when we learn the source of an evil it need exist no longer. The range of these climbing worms seems to be wide, for we have undoubted evidence of their attacking the grapevine, even in California, and I have found two species in Missouri, which have the same habit. Climbing cut-worms frequently have the same habit of severing plants, as those which have never been known to climb, and I very much incline to believe that this habit is only acquired in the spring time, and most cut-worms will mount trees if they are forced to do so, by the absence of herbaceous plants.

THE VARIEGATED CUT-WORM.—Pl. 1, Figs. 1, 2, 3 and 4.

(Larva of the Unarmed Rustic, *Agrotis inermis*, Harris.)

During the latter part of May, Mr. Isidor Bush, of Bushburg, Mo., brought me several greasy-looking worms, which had been feeding on, and doing considerable damage to a lot of young Creveling grapevines, which he had in cold frames. As I ascertained afterwards, upon visiting Mr. Bush's place, they lay concealed during the day, just under the surface of the rich earth, contained in the frames, and mounted the vines to feed, during the night time. The weather being warm, Mr. B. at my suggestion, threw open the frames during the day and allowed the chickens to get in them, and two days after doing this, there was not a worm to be found. By the 30th of May, these worms had grown to be of great size, measuring nigh two inches in length. When full grown they are mottled with dull flesh-color, brown and black, with elongated, velvety-black marks each side, as shown at Plate 1, Figure 2. The head is light gray and mottled, and marked as shown in Figure 3, and each segment on the back appears as in Figure 4 of the same plate.

About the time these worms were completing their growth, they having most likely developed earlier than usual, in the unnatural heat of the frames, I received from J. M. Shaffer, Secretary of the Iowa State Agricultural Society, some eggs which he found on a cherry twig. These eggs were quite small, of a pink color, with ribs radiating from a common centre, and were deposited in a batch. Exactly similar eggs, found on an apple twig, were presented to the Alton Horticultural Society, at its June meeting, by Mr. L. W. Lyon, of Bethalto, Ills.; while I subsequently found a batch of the very same eggs on a White mulberry LEAF, taken from a tree growing near St. Louis. Between the 24th and 30th of May, the young hatched from these eggs, in the shape of minute, thread-like worms of a dirty yellow color, and covered with the spots, already spoken of as occurring on all cut-worms, which are at this time in this species quite dark and conspicuous. In this early stage of their growth, they did not hide themselves

in the ground, and had, furthermore, the peculiarity of looping up the back when in motion, in the same manner as does the Canker-worm, and as do all other geometers or span worms. After the first moult, which took place six days after hatching, the dark spots became almost obliterated, the characteristic markings of this same Variegated cut-worm which I had received from Mr. Bush, began to appear, and they lost their looping habit. At this time they grew at an incredible rate, becoming thicker in proportion to their length as they grew older, and by the 15th of June, those which hatched on the 24th of May, had shed their skins four times, and gone into the ground, where they formed oval cocoons of earth, and in two days more were changed into chrysalids. By the 20th of June the moths began issuing, thus requiring but 35 days to go through all their transformations.

These worms were very voracious, and after the first moult, showed the true cut-worm characteristic of concealing themselves during the day, and feeding at night. Moreover, they proved to be quite universal feeders, for while I fed them, when young, on cabbage and grapevine leaves, they flourished exceedingly, the latter part of their lives, on the leaves of the White mulberry; and on the 16th of June, I dug up from my garden, two full grown specimens of this same kind of worm, which produced the same species of moth, each of them having severed a young lettuce plant. From the foregoing, it is manifest that all cut-worm moths do not deposit their eggs on the ground, and from the fact that these eggs were found, in one instance, on a leaf, so early in the season, they were undoubtedly deposited in the spring by a moth which must have passed the winter either in the chrysalis or moth state; and as the insect goes through its transformations so rapidly, there are most likely two broods during the year. From the foregoing experience, and from the fact that most other moths attach their eggs to different substances, I think it not unlikely that our cut-worm moths do the same, as a general rule, instead of depositing them in, or on the ground, as has heretofore been supposed; and Mr. Cochran has related to me a curious incident which bears me out in this belief. He is in the habit of gathering, during the winter, all crumpled leaves and egg-masses which he finds in his orchard, and of placing them in a drawer in his secretary. Last spring he was astonished to find several half-grown cut-worms in this drawer, they having evidently hatched from some of the eggs, and fed entirely on some apples which chanced at that time to be in the drawer.

The moth produced from this cut-worm is represented at Plate 1, Figure 1. Its general color is a dark brownish-gray, some specimens being almost black along the front edge of the upper wings, while others have this edge of a dull golden-buff color. The Noctuidæ, to which our cut-worm moths belong, have not yet been worked up by any one in this country, and as they are all of sombre colors, and as the species, in many instances, very closely resemble each other, it is not an easy matter to properly determine them. The species under

consideration, is apparently quite common here, and yet Mr. A. Grote of New York, who made a trip to Europe last year, for the purpose of comparing our American moths with those in the British museum, and in other European collections, took a specimen with him and brought it back unnamed. In the collection of Mr. A. Bolter, of Chicago, it is marked *Agrotis saucia*, Treitschke, while Mr. Cresson informs me that in the collection of the American Entomological Society, at Philadelphia, it is named *æqua*, but without authority. Harris's description of *inermis* (Inj. Insects, p. 444), brief and insufficient as it is, agrees with some of the individuals, and, as it is said to be the counterpart of *æqua* which is an European species, I have concluded, rather than to create more synonyms, to redescribe it below, under this name. Individuals among the numerous specimens which I bred from the same batch of eggs, differ greatly from one another, and I find this to be the case with all owlet moths. Indeed, with the present species, a description taken from any single specimen would scarcely suffice for any of the others, and it is not at all unlikely that this species has received different names from different authors.

AGROTIS INERMIS, Harris—*Larva*—Length, when full grown, 2 inches. Finely mottled with dull, carneous-brown and black, and having dark velvety longitudinal marks along subdorsal and stigmatal region (see Pl. 1, Fig. 2); segment 11 somewhat ridged and abruptly divided transversely by velvety black and carneous. Lighter laterally than above. A carneous stripe below stigmata. Venter and legs speckled glaucous. Dorsum of segments marked as in Plate 1, Figure 4; Head light gray, and marked as in Plate 1, Figure 3. Cervical shield obselete.

Chrysalis.—Of normal form, deep mahogony brown, with a single point at extremity.

Perfect insect.—Average length 0.80; alar expanse 1.80. Ground color of fore wings gray-brown, marked as in Plate 1, Figure 1. A most variable species, sometimes washed with dull carneous, at others with light buff, but always marked with more or less smoky black. Costal region, head and thorax, sometimes very black, at others bright golden-buff. Spots usually lighter than wing, though sometimes concolorous. Basal half and transverse lines more or less distinct, especially at costa, geminate, their middle space, usually lighter than the ground color. Hind wings pearly white, with a very slight pink tint in the middle, shaded behind and veined with smoky brown.

Under surface of the wings, the least variable and most characteristic feature, that of fore-wings being mouse-gray with a distinct ferruginous spot in the middle at base, and a lighter strip running from this spot to the posterior angle; the arcuated band very distinct and geminate at costa, and the whole surface pearly and especially the light strip at interior margin which in certain lights reflects all the prismatic colors. That of hind wings pearly white in the middle, darker near the margins, distinctly freckled along anterior margin, where the arcuated band is very distinct, while in the middle of the wing it is represented by distinct black strokes on the veins.

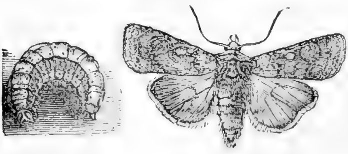
Described from 25 bred specimens.

THE DARK-SIDED CUT-WORM.

(Larva of the Cochran Rustic, *Agrotis Cochranii*, Riley.)

This worm is one of the most common of those which have the climbing habit. It is represented in the annexed Figure 26, at *a*.

[Fig. 26.]



a *b*

The general color is dingy ash-gray, but it is characterized more especially by the sides being darker than the rest of the body. When young, it is much darker, and the white, which is below the dark lateral band, is then cream-colored, and very distinct. It produces

a moth which may be known as the Cochran Rustic, and was first described in the *Prairie Farmer* of June 22, 1867. Speaking of the depredations of this worm, Mr Cochran says:

"In the beginning of the evening its activity is wonderful; moving along from limb to limb swiftly, and selecting at first only the blossom buds, to one of which having fastened, it does not let go its hold until the entire head is eaten out, and from this point, so thorough is its work, no latent or adventitious bud will ever again push. From a six-year old fruit tree, I have, on a single night, taken seventy-five of these worms, and, on the ensuing evening, found them well nigh as plenty on the same tree. When all the blossom buds of a tree are taken, it attacks with equal avidity the leaf buds. It is no unusual thing to find small trees with every bud that had pushed, from first intentions utterly destroyed, and frequently young orchards the first season planted on sandy grounds, lose from 50 to 75 per cent. of their trees; sometimes those remaining will be so badly injured as to linger along for a few years, fruiting prematurely each season, and then die, utterly drained of their vital principle by this dreadful enemy. The instinct of the perfect insect, like that of all insects injurious to vegetation, leads it unerringly to deposit its eggs where they will hatch out from the warmth of the sun, and where the larvæ is nearest to that food which is necessary to its existence: hence I never yet have found the eggs upon clay, or heavy cold grounds of any description, and on my carefully placing them in such situations they failed to hatch out. Can there be a stronger argument used for the appointment of a State Entomologist than the fact, that the habits of this enemy of horticulture, that has ruined millions of dollars worth of fruit trees in our country, has until recently been entirely unknown? I doubt whether one fruit grower in five hundred is even now aware of the presence of this curse on his grounds. There is not an orchard upon the sands of Michigan, or the light timber openings of Indiana, or the sandy ridges of our own State, but that has suffered greatly, many of them entirely ruined by its depredations. It is far more destructive to fruit trees than any other insect, infinitely more so than the canker worm, but unlike the other depredators of our orchard trees, it is easily kept in check, and at small expense permanently eradicated."

This species remains longer underground in the chrysalis state, than the preceding, and there is but one brood each year, the moths appearing through the months of July and August. The moth which is represented at Figure 26, *b*, is of a light warm gray color, and shaded with brown and umber.

Agrotis Cochranii, Riley—*Imago.*—Fore wings of a light warm cinereous, shaded with van-dyke brown and umber, the terminal space, except at apex, being darker and smoky. Basal, middle and limbal areas of almost equal width, the middle exceeding somewhat the others. A geminate dark basal half-line, usually quite distinct. Transverse anterior geminate, dark, somewhat irregularly undulate, and slightly obliquing outwards from costa to interior margin. Transverse posterior geminate, the inner line being dark, distinct and regularly undulate between the

nerves, while the outer line is plain and much paler; it is arcuated superiorly and inversely obliques for two-thirds its width. Orbicular and reniform spots of normal shape, having a fine, dark annulation, which is however obsolete in both, anteriorly; the orbicular is concolorous with the wing, whilst the reniform has a dark inner shade with a central light one, and forms with the transverse posterior a somewhat oval spot which is also dark. Median shade dark and distinct interiorly, shading off and becoming indistinct in center of wing, and quite dark between the two spots, giving them a fair relief. Subterminal line single, light, acutely and irregularly dentate, with an inner dark shade, but warmer than that of terminal space. Terminal line very fine, almost black, slightly undulate. Fringes of same color as wing, with a light central line, having an outer dark coincident shade. A dark costal spot in basal area; at termini of the usual lines, and two light ones in subterminal space. In some specimens one or two fine dark sagittate marks are discernable, and also a fine black claviform mark. Hind wings: whitish, with a darker shade along posterior margin. Under surface of fore wings somewhat lighter than the upper surface and pearlaceous interiorly, with a smoky arcuated band—more definite near the costa than elsewhere—and a tolerably distinct lunule. Under surface of hind wings concolorous; slightly irrorate with brown anteriorly and posteriorly, and with an indistinct lunule and band. Antennæ, prothorax, thorax, tegulæ and body of same color as primaries, the prothorax having a darker central line, and in common with the tegulæ a carneous margin. Under surface lighter; legs with the tarsi spotted.

This moth, in its general appearance, bears a great resemblance to *Hadena chenopodii*, but the two are found to differ essentially when compared. From specimens of *H. chenopodii*, kindly furnished me by Mr. Walsh, and named by Grote, I am enabled to give the essential differences, which are: 1st. In *A. Cochranii*, as already stated, the middle area exceeds somewhat in width either of the other two, while in *H. chenopodii* it is but half as wide as either. 2d. In the *Agrotis* the space between the spots and between the reniform and transverse posterior is dark, relieving the spots and giving them a light appearance, whilst in the *Hadena* this space is of the same color as the wing, and the reniform spot is dark. The claviform spot in the *Hadena* is also quite prominent, and one of its distinctive features, while in the *Agrotis* it is just about obsolete.

There are specimens that seem to be intermediate between these two, but all those bred by me, both male and female, were quite constant in their markings, and their intermediates will doubtless prove to be distinct species or mere varieties.

Larva—Length 1.07 inches. Slightly shagreened. General color, dingy ash-gray, with lighter or darker shadings. Dorsum light, inclining to flesh color, with a darker dingy line along its middle. The sides, particularly along the sub-dorsal line are of a darker shade. On each segment there are eight small, black, shiny, slightly elevated points, having the appearance of black sealing-wax, from each of which originates a small black bristle. The stigmata are of the same black color, and one of the black spots is placed quite close to them anteriorily. Head shiny and of the same dingy color as the body, with two darker marks, thick and almost joining at the upper surface, becoming thinner below and diverging toward the palpi. The upper surface of first segment is also shiny like the head. Ventral region of the same dingy color, but lighter, having a greenish tinge anteriorly and inclining to yellow under the anal segment. Legs of same color. It has a few short bristles on the anterior and posterior segments.

Chrysalis.—Length 0.70 of an inch. Light yellowish brown with a dusky line along top of abdomen. Joints, especially of the three segments immediately behind the wing-sheaths, dark brown. The brown part of these three segments, minutely punctured on the back. Eyes dark brown, and just above them, a smaller brownish spot. Two quite minute bristles at extremity.

Described from numerous bred specimens.

THE CLIMBING CUT-WORM—Pl. 1, Figs. 5, 6 and 7.

(Larva of the Climbing Rustic, *Agrotis scandens*, N. Sp.)

This is another of the most common species having the climbing habit. It occurs in at least five different States, for Mr. Walsh informs me that it is the species referred to by Mr. Townley, of Marquette county, Wisconsin, and I have found it with the same pernicious habit on Mr. Jordan's nursery at St. Louis, in our own State; while it was even more numerous, last spring, in North Illinois, North Indiana and West Michigan, than the preceding species, as I am informed by Mr. Cochran, and by Mr. H. D. Emery, of Chicago, who both sent me great numbers of specimens during the last week of April. The following

interesting letter accompanied those which were received from the last named gentleman:

"I made a nocturnal visit to Mr. Cochran's place, Monday night, for the purpose of observing the workings of this pest, and spent about $3\frac{1}{2}$ hours, until 1 o'clock in the morning, at the job. I found on some single dwarf trees over 50 at a time, and from that down, and they were on both apple, pear, peach and cherry. They commence ascending the trees soon after dark, and are found the most plenty from 11 to 12, some remaining on the trees until daylight, as I found several at 4 o'clock in the morning. Their first drive seems to be the terminal bud, and when these are all gone, they take side buds or even the bark of the tree in many cases, as you will see by the small twigs sent herein. You will see they are of different sizes. Some trees were entirely despoiled of the terminal buds. After they have eaten their fill, they seem to let themselves off the limb by a short web, and drop to the ground. We have found a large number of the worms attacked by the bug found in the tin box*. They would pierce the worm and suck him dry, and frequently two of them were hold of one worm. There were also numbers of spiders about the trees, of various sizes and kinds, all alive and alert, and apparently annoying if not preying upon the worms. Also a beetle, of which I send two specimens, was very active on the ground under the trees, apparently after prey †. The worms were the most abundant on the light sandy soils, and less frequent as the ground grew hard or clayey, and where it was pretty much all clay, scarcely one could be found. The tin tubes placed around the trunks of the trees, when properly adjusted, were a perfect protection. The injury they have already done is very great."

Mr. Cochran, speaking of the same worm, says: "Some trees were literally covered with them. Scarcely a bud but that had its worm, and, returning towards 10 o'clock, to those trees which we had in the early part of the night examined, we found others had come as abundantly as before. I have observed that they are actually ruining the young orchards along the Lake shore, and, strange as it may appear, their owners do not know what is doing the mischief. At Hyde park, where there are many handsome country residences with grounds of great beauty, this worm has been especially injurious to their young shrubbery."

This worm is represented at Plate 1, Figure 7. Its general color is a very light yellowish-gray, variegated with dirty bluish-green, and when filled with food it wears a much greener appearance than otherwise. In depth of shading it is variable however, and the young worm is of a more uniform dirty whitish-yellow, with the lines along the body less distinct but the shiny spots more so than in the full

* The bug was the Spined Soldier bug. (*Arma spinosa,* Dallas). See Figure 54.

† The Incrassated Geopinus (*Geopinus incrassatus,* Dej.) a beetle about $\frac{1}{2}$ inch long and of the color and polished appearance of thin glue.

grown ones. Mr. Cochran informs me that on the apple tree, when this worm has fed out its bud, the work is so effectually done, that no adventitious or accessory bud ever starts again from the same place; the worm, as it were, boring into the very heart of the wood and effectually destroying the ability of the tree to react, at such a point, in the formation of a new bud, and that consequently a tree that is once stripped generally dies, and that this occurs more frequently on small or dwarf trees, where the buds are few, and 3 or 4 worms in a single night can eat out every one. But I have noticed that with the grape-vine this is not generally the case, as a new bud almost always appears where one has been eaten off.

Great numbers of these worms which I reared to the moth state, were fed promiscuously on apple and grape-vine leaves. They began entering the earth on the 20th of May, and generally issued as moths nine days after thus disappearing; the last moth having issued on the 29th of June.

The moth produced from this worm is easily distinguished from most other owlet moths by its peculiar color. It seems allied to *Agrotis cursoria* of Europe, and also greatly resembles one that was described as *A. murænula*, by Mr. Grote, and figured in Volume 1, Number 4, of the American Entomological Transactions. Upon submitting specimens to Mr. Grote, however, he informed me that it is distinct and undescribed, and I have therefore named it the Climbing rustic (*Agrotis scandens*). It is well represented with extended wings at Plate 1, Figure 5, and with closed wings at Figure 6. The general color of the upper wings is a pearly bluish-gray, while the under wings are pearly white; but as with the other species, it varies greatly in color and appearance, and as I could pick out, from 30 individuals, at least 4 which, if taken singly would doubtless be described as distinct species, it is not unlikely that Mr. Grote's *murænula*, may prove identical with it after all.

AGROTIS SCANDENS, N. Sp.—*Larva.*—Average length when full grown 1.40. Ground-color very light yellowish gray, variegated with glaucous in the shape of different sized patches, which are distinctly seen under the lens, to be separated by fine lines of the light ground color. A well defined dorsal and less distinct subdorsal and stigmatal line, caused by these patches becoming larger and darker; another and still less distinct line of the same kind under stigmata. The dorsal line frequently with a very fine white line along its middle, especially at sutures of segments. Piliferous spots in the normal position; those above black, those at the sides lighter. Stigmata black. Head and cervical shield tawny, the latter with a small black spot each side, the former with two in front, and two eye-spots each side. Caudal plate tawny, speckled with black. Venter and legs glaucous. Bristles fine and small. Filled with food it wears a much greener appearance than otherwise, while when young it is of a more uniform dirty whitish-yellow, the lines less distinct but the piliferous spots proportionately larger. Head quite variable in depth of shade.

Perfect Insect.—Average length 0.70; alar expanse 1.50. General color of fore wings very light pearly bluish-gray, with a perceptible deepening posteriorly. Quite variable, sometimes of a more decided blue, at others inclining to buff as in *Leucania unipunctata*, Haw. Markings, when distinct, as in Plate 1, Figures 5 and 6. With the exception of the reniform spot and subterminal line, however, they are usually distinct only on costa, being either indistinct or entirely obsolete on the rest of the wing. The subterminal line is light, with a more or less dark diffuse shade each side, which, in some instances, forms into sagittate spots. A black stain at the lower part of reniform spot forms a most distinctive character. Hind wings very pale and lacking the bluish cast of

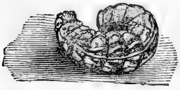
fore wings; lunule distinct, and a dark shade, enclosing a lighter mark, as in *Heliothis*, along posterior margin. Eyes dark; head and thorax same as fore wings; abdomen same as hind wings. The whole under surface the same as hind wings above, the lunules and arcuated bands faintly traced, the fore wings having a darker shade in the middle.

Described from 30 bred specimens.

THE W-MARKED CUT-WORM.—Pl. 1, Fig. 13.
(Larva of the Clandestine Owlet moth, *Noctua clandestina*, Harris.)

Another cut-worm which has this same habit of climbing trees, I have named the W-marked cut-worm, on account of the characteristic markings resembling this letter, which it has on its back. Its general color is ash-gray, inclining on the back and upper sides to dirty yellow, and the annexed Figure 27 gives a correct view of it. This species, so far as I have observed, though it has been caught in the act of eating apple buds, is but seldom found very high up on trees, but seems to prefer to attack low bushes, such as currants, on which I have often found it. It occurs abundantly on a species of wild endive (probably *Cichorium sativa*), under the broad leaves of which it frequently nestles during the day, without entering into the ground. Harris quotes a communication from Dr. F. E. Melsheimer, of Dover, Pa., in which this same worm is said to attack young corn, and to feed indiscriminately on all succulent plants, such as early sown buckwheat, young pumpkin-plants, young beans, cabbage plants, and many other field and garden vegetables. Mr. Glover, of the Department of Agriculture, has also found it to attack wheat, and I have found it quite injurious to young cabbages. In feeding, it frequently drags its food under stones and other places of concealment. The young worms are of a more decided gray than the older ones, with the black W-shaped marks less distinct, and subsist, for the most part, on grasses.

[Fig. 27.]



The moth produced from this worm is illustrated at Plate 1, Figure 13. It appears during the latter part of June, and is, consequently, one of our earliest. It is of a dark ash-gray color, with the wavy bands but faintly traced. The two ordinary spots are small, narrow, and usually connected by a fine black line. The hind wings are dirty brownish-white, somewhat darker behind. It may be popularly known as the Clandestine Owlet moth, and was named *Noctua clandestina*, by Harris, though it might be placed with more propriety in the genus *Graphiphora*.

NOCTUA CLANDESTINA, Harris.—*Larva*—Length, when full grown, 1.15 of an inch. General color ash-gray, inclining on the back and upper sides to dirty yellow. Finely speckled all over with black and brown spots. Along the dorsum there is a fine line of a lighter color, shaded on each side, at the ring joints with a darker color. Sub-dorsal line light sulphur-yellow, with a band of dirty brownish-yellow underneath. Along the stigmatal region is a wavy line of a dark shade, with flesh-colored markings underneath it; but the distinguishing feature is a row of black velvety marks along each side of the back, on all but the thoracic segments, and bearing a general resemblance, looking from anus to head, to the letter W. Ventral region greenish-gray; prolegs of same color; thoracic legs brown-black. Head black, with a white line in front resembling an inverted Y, and white at sides. The thoracic segments frequently have a greenish hue.

Chrysalis.—Of the normal form and color, with but one rather long thorn at extremity.

THE GREASY CUT-WORM.—Pl. 1, Figs. 8, 9 and 10.
(Larva of the Lance Rustic, *Agrotis telifera*, Harris.)

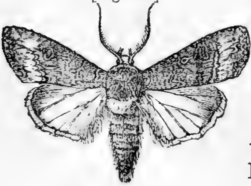
In the *Prairie Farmer* for June 22, 1867, I described a large cut-worm under the name of the "Black cut-worm." I have since ascertained that it is quite variable in its coloration, some specimens being lighter, and the markings much more distinct than in others, and have therefore concluded to give it the above appellation. This worm is usually of a deep leaden-brown inclining to black, though some specimens are of a greasy glancous color, with a dark flesh-colored back. It is always more or less distinctly marked as in Figure 9, of Plate 1, while the head, when retracted within the first segment, presents the appearance of Figure 10 on the same plate, this figure being enlarged beyond the natural size. It is probably the most common cut-worm in the country, for the moth is frequently caught in our rooms in all parts of the United States. Though it has not, so far as I am aware, the climbing habit of the preceding species, it has a most emphatic and pernicious *cutting* habit.

Mr. Jordan, of the St. Louis nursery, had transplanted a great number of tomato plants last spring, but lost well-nigh every one of them by this pernicious worm. It cut off large plants that were over six inches in height, generally at about an inch above ground, and thus effectually destroyed them. After severing one plant, the same worm would travel to others, and thus in a single night, from three to four plants would be ruined by a single individual. Along the Clayton road, to the west of St. Louis, most of the corn had to be replanted on account of its attacks. On the 22d of May I examined several fields, and was surprised to find these worms present at almost every hill, most of them being two-thirds grown. The land is clayey, and was at that time quite hard, and each worm had a smooth burrow in which it lay hidden, and to the bottom of which it could generally be traced. I subsequently learned that a large tobacco field belonging to Mr. F. R. Allen, of Allenton, had been entirely ruined soon after it was planted, by this same worm, and I found it in my own garden cutting off cypress vines. Indeed, nothing seems to come amiss to its voracious appetite, for in confinement it devoured with equal relish, apple and grape leaves.

This species comes to its growth in this latitude by the end of May, though the moth does not make its appearance till the month of July.

The moth is known as the Lance Rustic (*Agrotis telifera*, Harris), and is represented in the annexed Figure 28, and still more correctly at Plate 1, Figure 8. The upper wings are light-brown shaded with dark-brown, and the under wings are pearly white, with a gray shade around the edges; but the characteristic feature, from which it takes its name, is a dark-brown lance-shaped mark running outwardly from the kidney-spot.

[Fig. 28.]



AGROTIS TELIFERA, Harris—*Larva*—(Pl. 1, Fig. 9)—Length 1.50@1.60 inches when crawling. General color above, dull dark leaden-brown. A faint trace of a dirty yellow-white line along dorsum. Subdorsal line more distinct, and between it and stigmata two other indistinct pale lines. Eight black shiny piliferous spots on each segment; two near subdorsal line, the smaller a little above anteriorly; the larger just below it, a little back of the middle of the segment, with the line appearing especially light above it. The other two are placed each side of stigmata, the one anteriorly a little above, the other just behind, in the same line with them, and having a white shade above it. Head light brown, with a dark brown spot each side and dark brown above, leaving the inverted Y mark in the middle, light brown, and having much the appearance of a goblet, as one looks from tail to head. Cervical shield dark brown, except a stripe above and each side. Sparse short white bristles laterally and posteriorly. Venter and pro-legs of a glaucous glassy color. Thoracic legs light brown.

It varies considerably in depth of shading, and some of the lighter specimens have the lateral stripes quite distinct, and the dorsum is frequently of a dull carneous with a darker shade, divided by a fine line of a lighter color, along the middle. There is frequently a third piliferous spot near the stigmata.

Chrysalis.—Average length 0.54 of an inch, very pale shiny yellowish-brown, with two large dark brown eye-spots. Stigmata and anterior edge of four largest abdominal segments on the back, also dark brown and shagreened. Two minute thorns at extremity.

Imago.—As Harris's description, as given in his "Injurious Insects," is not very complete, I subjoin a more detailed one: Average expanse 1.60 inches. Color of fore-wings brownish-gray, verging into a very dark brown, with a bluish tint at the costa, for nearly one-third the width of the wing. Middle area somewhat darker than basal and limbal, the latter being especially light at the apex, and between transverse posterior and subterminal lines; having distinct spots on the nerves, and two distinct sagittate marks. Ordinary spots dark, with a very fine dark brown annulation, especially distinct around the dentiform. Reniform spot of normal shape. Orbicular nearly oval, and generally elongated into a point posteriorly. Distinguishing feature a dark brown lance-shaped mark, running from posterior portion of reniform spot. Transverse anterior geminate, dark. T. posterior geminate, dark, projected and arcuated above. Subterminal line light, irregular and festooned. Median band distinct. Subterminal space dark, especially where broadest, at nerves 5, 6 and 7. Margins dark brown, with a lighter inward, angular rim between each nerve. Costa with usual spots. Fringes light, with a central line, the inner half having dark square spots on the nerves. Hind wings pearly white, semi-transparent, margined behind and veined with dusky gray. Fringes even whiter, with a faint darker line. Under side of fore wings pearly-gray; hind wings concolorous, but with a broad band of speckled gray on the anterior margin. Legs dark, with light spots at joints. Head often rust-brown. Antennæ brownish. Prothorax very clearly defined, and of a rich dark brown at margins. Thorax and body light lilaceous-gray, the tegulæ being rimmed with flesh color.

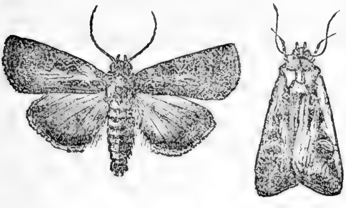
THE WESTERN STRIPED CUT-WORM.

(Larva of the Gothic Dart, *Agrotis subgothica*, Haworth).

Dr. Fitch, in his Second Report, on noxious insects of the State of New York, describes a cut-worm by the name of the "Striped cut-worm," (p. 313), In his 9th Report, (pp. 245–8), this worm was very fully re-described, together with the moth which it produces. This worm seems to have done great injury to the corn crop in the East, and the moth is a variety of the Corn Rustic (*Agrotis nigricans*, Linn,) which Dr. Fitch named *maizi*. It will be referred to on page 87. From worms, found in an orchard, and answering entirely to that description. I have bred numerous specimens of one of our most common owlet moths, namely, the Gothic Dart (*Agrotis subgothica*, Haworth.) As the worms are so similar in appearance, I have called the one under consideration, the "Western Striped Cut-worm," as no other name would better characterize it, though it is evidently as common in the East as it is in the West. Its general appearance is not

greatly unlike that of the "Greasy Cut-worm" already described, but its average size is but 1¼ inches. The ground color is dirty white or ash-gray and it has three broad dark lines, and two light narrow ones along the sides, and a light one, edged on each side with a dark one, along the middle of the back. This species remains longer in the ground than any of the others, and the moth does not appear till August and September. The moth is represented at Figure 29, *a*, with the wings expanded, and at *b* with the wings closed. Its markings are so conspicuous and characteristic that it suffices to say that the light parts are of grayish flesh-color, and the dark parts of a deep brown. It was first described in the year 1810 by Mr. Haworth, and is supposed to be an English insect; but as it is quite rare in England, and very common in this country, Dr. Fitch concludes, and I think rightly, that it is an American insect, the eggs or larvæ of which have accidentally been carried to England.

[Fig. 29.]



a *b*

AGROTIS SUBGOTHICA, HAW.—*Larva.*—Length 1.25 inches. Ground color dirty white or ash-gray, inclining in some instances to yellowish. A whitish dorsal line edged on each side with a dark one. Three lateral dark broader stripes—the lower one broadest of all—separated by two pale ones. Quite often an indistinct glaucous white stripe under the lower broad dark one. Piliferous spots of good size. Head shiny black, or in some individuals finely speckled with white, especially at the sides; with the usual forked white line like an inverted Y. Cervical shield, or upper portion of the first segment, of the same shiny color as the head, with a white stripe in the middle, contiguous to that on the head, and another each side. Venter dull white. Legs the same, varied with smoky brown.

THE DINGY CUT-WORM—Pl. 1, Fig. 11.

(Larva of the Dart-bearing Rustic, *Agrotis jaculifera.*)

We have, in the West, another cut-worm, resembling the preceding species in almost every particular, the following being the only permanent differences: 1st, It never attains quite so large a size, 2d, it is generally darker and more dingy, and the longitudinal lines are consequently less distinct; 3d, it is generally of a more decided dull pale buff color on the back.

On the 27th of last June, I received several of these cut-worms from Mr. Horace Starkey, of Rockford, Illinois, with a statement that they were proving quite destructive in the gardens of that vicinity, but without specifying what particular plants they attacked. They entered the ground soon after being received, and by the 7th of July, had all changed to chrysalids. The chrysalis differs from most of the others, in being of a very light honey-yellow, shaded with brown, with the eyes dark brown, and two sub-quadrate spots of the same color on the wing-sheaths, just above the antennæ. It measures 0.65 of an inch in length. The moths began to issue on the 2d of September, and proved to be a species very closely allied to the preceding. Indeed the markings on the wings are almost exactly the same; but it

is a smaller species, seldom expanding more than 1.25 inches and differs materially upon a strict comparison, and especially in the ground color being lighter and more silvery. It is faithfully represented at Plate 1, Figure 11. This species, as I am kindly informed by Mr. Cresson, is marked *Agrotis jaculifera* in the collection of the American Entomological Society, but without authorship; and as the name seems appropriate I have retained it.

Thus we have in this country, at least three species of cut-worms, which differ no more from one another in general appearance, than do individuals of the same species; and yet they all produce distinct moths, though it is worthy of remark that the moths produced from worms so resembling each other, viz: *Agrotis nigricans*, var *maizi*, *A. subgothica* and *A jaculifera;* have, all three of them, the space between and behind the two ordinary spots on the front wings of a dark brown color. It is possible that each of these species may have a different habit, but time, and further investigation will alone determine the point.

AGROTIS JACULIFERA—*Larva*—Length one inch. Similarly marked to that of *Agrotis subgothica*, with the colors darker and more dingy, the longitudinal lines less conspicuous, and the dorsum of a more decided pale buff color.

Chrysalis—Length 0.65–0.70. Color honey-yellow with dull brown shadings, and dark-brown eyes, but characterized especially by two subquadrate dark spots on the wing-sheaths just above antennæ.

Perfect insect—Much resembling *A, subgothica*, Haw., being marked as at Plate 1, Figure 11. It differs from that species in the following respects: The average expanse is but 1.30. The whole ground-color is colder (to use the language of the artist), i. e., of a whiter gray, with less of the buff color. The costa is darker, and the light costal band narrower; the posterior median nerve is almost white and very distinct to the lower part of the reniform spot; nerves 3, 4 and 5 are well relieved by light margins; the streak running between nerves 2 and 3 is very distinct and less diffuse; the terminal space is darker, and the inner margin only broken by nerves 4 and 5; there are no sagittate spots, while the posterior margin is very clearly defined by a black line bounded outwardly by a light one.

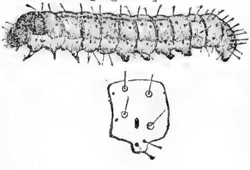
Described from three bred specimens.

THE GLASSY CUT-WORM.

(Larva of the Devastating Dart, *Agrotis devastator*, Brace.)

In the year 1819, in a short article upon the cut-worm, published in the first volume of Silliman's Journal, p. 157, Mr. Brace, of Litchfield, Connecticut, gave an account of this moth, which he bred from pupæ that were found a few inches under the ground, in a cabbage patch. He did not describe the worm which produced the pupæ, as he evidently supposed there was but one kind of cut-worm in existence. Consequently, up to the present day the larva of this common Devastating Dart moth has been unknown. It was my good fortune to breed this moth from the larva state. The cut-worm from which it

[Fig. 30.]



was produced, was found on the 12th of May under a wild endive plant, upon the leaves of which it had evidently been feeding. It was but half grown, and, being placed in a jar half filled with earth, that contained growing grass, it burrowed into the earth and after once casting its skin, fed entirely

on the roots of the grass, though other food was thrown into the jar. On the 7th of June it measured 1.80 inches when crawling, and on the 19th of the same month had changed to a chrysalis from which the moth emerged on the 7th of July. The worm is represented at Figure 30, and may at once be distinguished from all others of its tribe, that are known, by its translucent glassy green body, in contrast with a very distinct hard, polished, dark-brown shield on the first segment, and a bright venetian-red head. The usual spots on the body are quite distinct, and placed in the positions given at the lower outline of Figure 30, which represents the side of one of the middle segments.

The moth bears a close general resemblance to the Cochran Rustic already described, the ground color being the same. It differs in its larger size; in the wavy transverse lines being more equidistant; in the spots in the shape of arrow heads, which emanate from the inside of the last or outer line, being darker and more distinct; and in the outer edge of the large kidney-shaped spot being almost always quite white. Entomologically, it differs still more essentially, for though named *Agrotis devastator*, it seems to belong to the genus *Mamestra*. Here we have the converse of the facts given, in speaking of the Dingy cut-worm, for, closely as the Cochran Rustic and this Devastating Dart moth resembles each other, their larvæ are very dissimilar.

AGROTIS (MAMESTRA) DEVASTATOR, Brace—*Larva.*—Length 1.80. Color translucent glassy green, with a tinge of blue. Usually, a very deep bluish dorsal line. Four distinct piliferous spots on each segment, each with a slight annulation. Two other minute simple spots, without hairs on the anterior edge of the segment (see Fig. 30,). Head, bright Venetian-red, with black jaws, and a small black spot each side. Cervical shield, very distinct, hard, polished and of a dark brown. Caudal plate, less defined and more dusky. The body is lighter posteriorly than anteriorly and the dorsal line is most distinct along the middle segments.

Chrysalis—Quite dark mahogany brown, with the body somewhat more attenuated than is usual, and with two distinct slightly curved thorns at extremity with several other stiff bristles around them.

THE SPECKLED CUT-WORM—Pl. 1, Figs. 14, 15, 16 and 17.
(Larva of the Subjoined Hadena, *Hadena subjuncta*, Gr. & Rob.)

At two different times, I have found in a truck garden hiding in the ground, under cabbage plants, near St. Louis, a cut-worm which may be known by the above name. On one occasion, I also received the same worm from my friend, Mr. A. Bolter, of Chicago, who found it in Wisconsin. It is at once distinguished from all others that are known by several characteristics, but more especially by being speckled as with pepper and salt, when viewed with a pocket lens, the ground color being flesh-gray, with a tinge of rust color in the middle of each segment. The head is marked as in Figure 15, each segment on the back as in Figure 16, and the extremity as in Figure 17 of Plate 1—these figures being enlarged the better to show the markings.

Those which I bred, fed voraciously on cabbage leaves during the night and lay concealed and motionless during the day. Before

changing to chrysalids, they became of a uniform pale dirty yellow, with the markings almost entirely obliterated. The chrysalis is of the usual form and the moths appeared between the 2d and 8th of August. The kind of moth that was produced from these worms is faithfully represented at Plate 1, Figure 14, the front wings being marked as in the figure, with grayish-brown and black, and having a dull flesh-colored shade. It differs essentially from all those that I have hitherto described, and belongs to a different genus (*Hadena*). It was named *Hadena subjuncta* by Guénée, in his MS. and this name has been retained by Messrs. Grote & Robinson, in their description of it published in the Transactions of the American Entomological Society, Volume II, pp. 198–9, which will be found below.

HADENA SUBJUNCTA, Gr. & Rob.—*Larva.*—Average length 1.60 inches. Color carneous-gray, inclining to ferruginous in the middle of each segment. Minutely speckled as with pepper and salt. A lateral stigmatal stripe, somewhat lighter than the rest of the body. An interrupted dorsal and subdorsal white line, these lines being quite distinct on the posterior half and indistinct on the anterior half of each segment. Two distinct spots anteriorly on the dorsum of each segment; the other spots obsolete. Head light shiny brown, with two outwardly diverging darker marks. Segment 1, with the three longitudinal white lines and a white anterior edge, shaded on the inside with dark brown. Anal segment with a white transverse line, somewhat in the shape of a drawn-out W, and with a deep shade above it. Venter glaucous. Legs of the same color.

Chrysalis.—Of a deep brown color, rather short and thick, and with two bristles at extremity.

Imago—(Pl. 1, fig. 14). Length 0.65; expanse 1.50. ♂ ♀.—Antennæ simple, finely and shortly ciliate beneath. Carneous brown. Head with a dark frontal line. Prothoracic pieces with a very distinct and deep brown line. Abdomen crested above at base, with a spreading anal tuft in the male. Fore wings, above, blackish brown shaded with carneous. A longitudinal deep brown basal ray, shaded inferiorly, extending outwardly and narrowly to the transverse anterior line. Above this ray, the base is tinged with carneous, and the basal line is indicated by a dark geminate costal streak. Transverse anterior line geminate, the outer line the darker, roundedly and evenly interspaceally waved, nearly prependicular. Ordinary spots very large, distinctly limited. The median space is wide superiorly, but is constricted below the median nervure; a longitudinal deep brown streak runs along the submedian fold and connects the two median lines at their point of greatest contiguity. This streak becomes the lower margin of the claviform spot which abutts from the transverse anterior line, and whose upper margin is seen in a very distinct deep brown line running outwardly and downwardly obliquely from the median nervure. Above the claviform is the large obicular, pale, with a distinct annulus. The reniform is wide, of the ordinary shape, with an indistinct central shade and the distinct annulus is often obsolete outwardly. Beyond the reniform, the wing is shaded with carneous to the subterminal line, this shade spreading inferiorly. A diffuse and faint blackish median shade runs from the costa downward between the ordinary spots and is discontinued below median nervure. The transverse posterior line is incepted above the reniform, runs outwardly straightly along the costal region, thence downwardly over the nervules, bending inwardly beneath the reniform spot. It is geminate, faint, the lines enclosing a paler space and interspaceally lunulate. Subterminal line pale, preceded by a dark shade, forming the usual M-shaped mark at the middle, the points of the M attaining the external margin. The dark shading is sometimes tinged with olivaceous before the internal angle as is the inferior shading of the longitudinal streak connecting the median lines. The terminal space is blackish brown and black interspaceal marks precede the terminal line. The fringes are uneven; the external margin of the wing retires inwardly before internal angle.

Hind wings smoky blackish, paler towards the base, without discernable discal mark or lines. Under surface pale. The wings terminally and along costal edges are covered with powdery squamation with intermixed dark scales bringing the nervules into relief. The fore wings show three ante-apical white dots and the white subterminal shade line emanates from a fourth and larger dot just before the apex, these latter at times hardly discernable. Faint discal dots; sometimes traces of dark median lines can be seen on both wings.

THE SMALL WHITE BRISTLY CUT-WORM.
(Larva of the Figure 8 Minor, *Celæna renigera*, Stephens).

During the month of August in North Illinois, a small dirty-white cut-worm may frequently be found in flower gardens, where it doubtless feeds for the most part on the roots of various flowers. This worm is represented at Figure 31 *b*. It never gets to be more than ¾ of an inch in length, and is covered with distinct, stiff yellow bristles, and may be popularly known by the above name. During the fore part of August it descends deeper into the ground, and soon changes to a very bright shiny, mahogany brown chrysalis, from which in about three weeks afterwards, the moth emerges.

[Fig. 31.]

a b

This moth is represented (as well as a wood cut can represent it) at Figure 31 *a*. It is quite prettily marked, the fore-wings being brown, variegated with lilac-gray and moss-green, with a deep brown spot about the middle and a silvery annulation around the kidney-shaped spot. It is the *Celæna renigera* of Stephens of which *C. herbimacula*, Guénée is a synonym, and as it should have a popular name, it may be called the "Figure 8 Minor," in allusion to the silvery edge of the kidney-spot which almost always reminds one of the figure 8. In the genus *Celæna* the wings are entire, broad and rounded, and there is a conspicuous tuft on the crown of the head. The species may at once be distinguished from those of *Agrotis* and *Hadena* by their smaller size and more rounded appearance.

CELÆNA RENIGERA, Stephens.—*Larva.*—Length 0.75 of an inch.—Color dusky salmon-yellow, the dusky dirty appearance, caused by innamerable dark specks all over it. Largest at the four middle segments and tapering thence each way. A dark lateral stripe, distinct on the middle segments, indistinct at both ends. Distinguishing feature, very visible stiff yellowish bristles, proceeding from the usual spots which are small. A dorsal line is indicated under the glass by two indistinct thin lines at the joints of the segments.

Chrysalis.—Length 0.56 of an inch; concise; of a bright polished mahogany brown, with dark eyes and very slightly punctured on the anterior portion of the abdominal segments.

Imago.—Expanse 1.10 inches. Fore wings brownish-gray, with a more or less determined carneous or lilaceous hue. Orbicular spot sub-obsolete; sometimes entirely obsolete. Reniform spot of normal shape, moss-green, with a snow-white annulation, indistinct above; broad and distinct below. Ordinary lines lighter. Basal half-line distinct only on costa, and below posterior median nerve. Transverse anterior single, obliquing but slightly, and bordered posteriorly with a very thin broken darker line; it is moss-green in the middle, and there is a green shade running from it to the basal half-line, dividing the sub-basal space. Opposite this green in the median space, is a dark subquadrate almost black spot, and between the stigma the wings are also quite dark. Transverse posterior single, posteriorly oblique a little more than ⅓ of breadth of wing, then parallel with posterior margin, forming at the second nerve a roundish spot which extends to the anal angle, and is dark below and moss-green above. Subterminal line usually very indistinct—merely indicated by a few dots. A median arcuated band is perceptible, being broader and darker between the stigma and interrupted in the middle by lower portion of reniform spot. A minute light spot on each vein at posterior margin. Costa with a light spot at terminus of sub-basal line, of transverse anterior, and above reniform spots—dark each side of these and at terminus of median band; concolorous with wing at subterminal space, having four very minute light spots, one at ends of subterminal and transverse posterior lines, and two between them. Fringes concolorous with the wing, having a very fine darker edge.

Hind wings carneous-gray at base and interiorly—darker anteriorly and posteriorly and especially at posterior margin. Nerves and lunule rather dark. Fringes same color as interior of wing, with a darker central line.

Under surface of fore wings brownish-gray, the fringes and transverse posterior darker and the spots faintly marked at costa. Under surface of hind wings of same color above, lighter below, with the lunule dark and the arcuated band distinct.

Legs dark-gray with light spots at joints; palpi same color. Head, prothorax and thorax not quite so purplish as wings. Prothorax with a light margin at junction of wings—the tegulæ also with a light spot. Body same color as hind wings above, darker below. Feelers same.

OTHER CUT-WORMS.

Besides the ten distinct cut-worms, whose transformations I have just recorded, there are two others, which Dr. Fitch has described in all their stages. The one is the "STRIPED" or "CORN CUT WORM" as he calls it, which proves very injurious to corn, by cutting it off about an inch *above* ground. This worm produces a dusky-gray moth (*Agrotis nigricans*, Linn.—var. *maizi*), which is distinguished principally by two coal black spots, one nearly square, placed outside of the centre of the fore wing, and the other nearly triangular, a little forward of it, a roundish nearly white spot separating them. The other which Dr. Fitch has called the "YELLOW-HEADED CUT-WORM," is of a shining livid color, with a yellowish or chestnut-colored head and a horny spot of the same color on the top of the first and last rings. It is a large species and produces the Amputating Brocade moth (*Hadena amputatrix*, Fitch), which is figured on page 450, of Harris' work. This moth is distinguished by its Spanish-brown upper wings, marked with a large pale kidney-shaped spot, and a broad wavy blue-gray band near the end. The worm was found by Dr. Fitch to be even more injurious to corn than the striped species, since it severs the plant *below* ground; while it also combines the habit of climbing trees during the night, according to Harris.

Thus, we are now acquainted with the natural history of just one dozen of these cut-worms, while there is fully another dozen whose habits and history yet remain to be studied. Of one of these, especial- soon to give the complete history. Meanwhile, I will give a brief account of the worm itself, which may be known as

THE WHEAT CUT-WORM.

On the 10th of October, 1868, I received from Mr. F. R. Allen, of Allenton, Missouri, the following communication:

"Enclosed I send you some specimens of a worm that seems to be preying upon the recently sown wheat. My neighbor, Mr. George W. Moore, informed me a day or two ago, that a worm was eating all his wheat that he had lately sown in oats ground. I went to see what it was yesterday, and as I am not entomologist enough to tell, I refer them to you. Mr. Moore has learned within a day or two, that this same insect is now generally preying on the wheat in Franklin county, that is sown on oats stubble. What is remarkable they do not yet trouble the wheat in the same field sown on wheat stubble. Nor do

they seem to feed on the volunteer oats in the same field, but entirely destroy the young wheat."

Subsequently, upon visiting Allenton, Eureka, and other places in St. Louis county, I ascertained from L. D. Votaw and others, that this worm had been known to attack wheat in the fall for many years back. They come to their growth the latter part of October, descend into the earth and pass the winter in the chrysalis state. The only manner in which I can account for their appearing only on that wheat which was sown on oats stubble, is by supposing that the scattering oats that were left after harvest had sprouted before the wheat, and had thus attracted the parent moths. On this supposition the worms had hatched and fed awhile, before the ground was ploughed, and planted to fall wheat, and this seems the more likely, since the worms were full-grown, almost as soon as the wheat appeared above ground. If this supposition be correct, the attacks of this worm can be effectually prevented by ploughing the land early and keeping the ground clear of all vegetation until the wheat is planted. No other rational explanation can be given, for I found by experiment that they would devour with equal relish the young plants of both oats, wheat, and a variety of grasses.

In the *Canada Farmer* for April 15, 1867, an account was given of the ravages of "cut-worms" on Spring wheat, in the county of Huron. Judging from the account however, the worm referred to, was the common "White grub;" but if it be the same as that spoken of above, the fact can be ascertained by the description which I subjoin herewith.

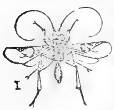
THE WHEAT CUT-WORM.—A dark pitchy black cut-worm, the characteristic mark being, a very distinct pale buff or flesh-colored stigmatal band. Dorsum generally of a brownish shade, the dorsal line of the same color, with a more or less distinct dingy shade each side of it. The subdorsal region is always the darkest part of the worm, being of a pitchy brown; but edged above, at junction of dorsum, with a fine light buff-colored line, and generally variegated in the middle, with very minute light colored irrorations. Eight sealing-wax-like black elevated piliferous spots on each segment, those on dorsum usually having a white base outwardly. Greatest width at segments 10 and 11, the spots upon them being also the largest. Head, deep polished brown, with the usual inverted Y-shaped white mark, and some white spots at sides; also with white lips, and perfectly white palpi. Cervical shield, of same color as dorsum, but polished, and with the dorsal and sub-dorsal white lines quite distinct upon it. Caudal plate with a bright cream-colored longitudinal dash (generally constricted in the middle) between two black spots. Venter and legs glassy glaucous. The young worm is almost uniformly pitchy black, with the light stigmatal band always visible however. Indeed this band is always constant no matter how much the worms vary in depth of ground-color.

There are various other naked caterpillars which are frequently found upon the ground near vegetation of various kinds. Thus during the months of July and August, a species with the back of each segment very characteristically marked as represented at Plate 1, Figure 12, may often be found. It seems to feed on a variety of herbs, and produces a prettily variegated moth known as *Prodenia commelinæ*, Guénée; but though this and other species may have the cutting habit, they have never attracted notice so far, and I shall pass them over and proceed at once to suggest the proper preventives and

REMEDIES AGAINST CUT WORMS.

Natural Remedies.—These cut-worms, like all other vegetable-feeding insects, have numerous insect enemies which are continually on the alert for them, and materially assist us in keeping them in due bounds. Of those that are parasitic internally may be mentioned the minute four-winged flies belonging to the genus *Microgaster*. One of these which is parasitic on the Army-worm (the *M. militaris* of Walsh) is represented at Figure 32, and it bears a strong resemblance to an undescribed species which I have often bred from a cut-worm, described in the *Prairie Farmer* as the "Pale cut-worm." The female fly punctures the tender skin of the worm and deposits great numbers of eggs in the body. These eggs produce maggots which live upon the fatty parts of the worm, and slowly but surely produce the death of their victim. When full grown they pierce the skin of the worm and spin their white silken cocoons, in company, on his body, and in due time issue forth as flies.

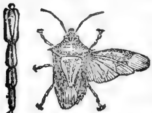
[Fig. 32.]



There is also a large yellowish-brown four-winged Ichneumon fly (the *Paniscus geminatus* of Say), which I have bred from cut worms. The parent fly deposits a single egg within the body of a worm, but the maggot hatching from this egg does not cause the worm to die, till after the latter has entered the earth to become a chrysalis. At this point the worm suddenly succumbs and the maggot spins a tough, black, smooth cocoon, and where we expected to see a moth rise to day-light, we behold in time this Ichneumon fly.

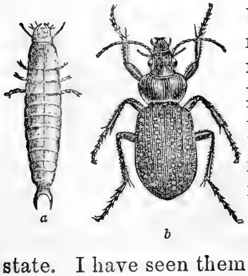
Among the cannibals, that bodily devour these worms, may be mentioned the Spined Soldier-bug, already referred to on page 77, note, and whose likeness I produce at Figure 33. This fellow is such a thorough cannibal, and so serviceable to man, that his portrait cannot be too well graven on the mind. It is not unlikely, also, that most of the ground beetles that are figured in a future chapter on the 10-lined Potato beetle, prey upon cut-worms; and the Homely Geopinus referred to in the note on page 77 has been found to do so, but by far the most efficient insect in slaying these worms is the larva of the Fiery Ground beetle (*Calosoma calidum*, Fabr.), which I represent at Figure 34 *a*, by the side of its parent Figure 34 *b*. This larva has very appropriately been called the Cut-worm lion, by Dr. Shimer of Mt. Carroll, Illinois, who gives the following account of its mode of transformation to the perfect beetle: "The fat, full grown larva of *Calosoma calidum* chooses a hard piece of ground, as a wagon road in the field, where it bores into to pass the pupa state. I have seen them many hours in boring a few inches. These

[Fig. 33.]



a *b*

[Fig. 34.]



a *b*

fierce insects often wage terrible battles when they encounter each other, and they will eat each other as readily as cut-worms, as I found whenever I put more than one of them into my collecting box. He that would breed these insects to the perfect state, must pack the dirt in his breeding box as hard as a wagon road, or be will fail, as I always did before I saw their operations in the field. In using moderately compact earth, the larva digs it over and over, endeavoring to find a suitably dense place, works up the dirt into balls, until its feet are clogged up with earth and juices from its mouth, and it sinks exhausted and dies. In a few days after it enters the ground, the beautiful spotted, perfect beetle appears, and, strangely, the smell of the beetle is peculiar and entirely different from the larva."

This Cut-worm lion has quite a formidable appearance, and is exceedingly agile. It is flattened, of a black color, with six legs upon the breast, and a pair of sharp hook-like jaws projecting in front of its head. It pursues the worms in their retreats under the ground, and seizes them wherever it comes in contact with them. Sometimes a young Cut-worm lion will seize a worm twice as large as itself, and will cling with bull dog tenacity to its prey, through all its throes, its writhings and twistings, till at last the worm succumbs, exhausted, and the victor bites two or three holes through its skin and proceeds to suck out its juices.

Some kinds of spiders are also known to prey on cut-worms, and these unwisely unpopular little animals should always be cherished and protected. Poultry is also quite efficient in destroying them, and chickens are better than any other kind. I cannot too strongly urge their claims as cut-worm destroyers, than by giving the statement of Mr. Cochran, to-wit: that he believed he could not possibly have coped with the worms without the aid of a large brood of chickens which he procured for that purpose.

Artificial Remedies.—The climbing cut-worms are easily headed off by a little vigilance. From the orchard planted upon light, warm soils they can be driven away entirely by claying the ground about the trees; a wheelbarrow full is well nigh enough for each tree when spread around its base and as far as the limbs extend. This is the most thorough and lasting. A small strip of tin, three inches wide, carefully secured around the body of the tree, will effectually prevent their ascension; if the tin is old and rusty it will require to be a little wider. Each night, after the swelling of the bud, an hour or two after midnight a slight jar of the tree will bring every one on it down, when they can be caught in a spread sheet and destroyed. This will have to be followed up till the bud has unfolded into the leaf, after which there is no longer anything to be apprehended from the worm. The reasons why the clay is so efficient, are two-fold: 1st—The worms seem to have an instinctive dislike to crawling over it. 2nd—In dropping from the tree on to the hard surface they are frequently disabled, and whether disabled or not, they cannot immediately burrow into it

as in sand, and they are all the more exposed to their numerous midnight enemies which are ever watching for them.

For the common field cut-worms, I am convinced that there is no better remedy, as a rule, than hunting and killing them. It is generally believed that ashes and lime used about plants will keep off cut-worms, and I might fill pages with recorded experiments, going to prove the good effects of these substances. The experimenters generally forget, however, that there is a period in the life of these worms when they of themselves go down in the earth and disappear, and anything applied just before this happens is sure to be heralded forth as a perfect remedy. Experiments show, however, that when placed in a box with separate quantities of ashes, lime, salt and mold, they will burrow and hide in all of them, but especially in the ashes and mold. Soot seems to be more obnoxious to them, and, although I have not yet had an opportunity to give it a thorough test, I do not wish to discourage its trial. Fall plowing, to be efficacious, must be done very late in the fall, when the worms are numbed with cold, and then I think it is of doubtful utility further than it exposes them to the attacks of enemies, including birds.

In a case like that, communicated by Mr. Allen, it would pay to dig a narrow ditch around the part of the field infested, the outward side to be made smooth and slanting under; for these worms cannot crawl up a perpendicular bank of earth. On the same principle, many an one may be entrapped by making smooth holes with a stick around hills of corn or other plants, and on going over the same ground the next day, those that are thus entrapped can be crushed by the end of the same stick. In corn fields that have been subject to the attacks of cut-worms, it is well to plant so much seed as will enable them to glut their appetites without taking all the stalks in the hill, and in this light the following lines contain a deal of wisdom:

> "One for the black-bird and one for the crow,
> Two for the cut-worm and three to grow."

INSECTS INFESTING THE POTATO.

As the potato forms one of our leading articles of diet, and is universally cultivated, an accurate knowledge of the insects which attack it, is of the utmost importance. A very full account of them was given in the October and November numbers of the AMERICAN ENTOMOLOGIST, and since the editions of those two numbers are entirely exhausted, I cannot do better than to transfer it, for the most part, to the pages of this report, with such additions and alterations as I have since found necessary.

We often see paragraphs in the papers, stating that "THE Potato Bug" has been very abundant and destructive in such a month and at

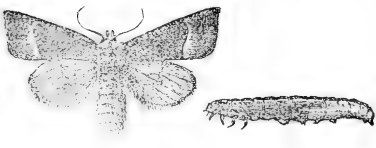
such and such a place. Accompanying these statements, remarks are frequently added, that "THE Potato Bug" is preyed upon by such and such insects, so that we may soon expect to see it swept from off the face of the earth; and that, even if this desirable event should not take place, "THE Potato Bug" may be checked and controlled by such and such remedies.

Do the worthy men, who indite these notable paragraphs, ever consider for one moment, that there are no less than eleven distinct species of bugs, preying upon the potato plant within the limits of the United States? That many of these eleven species are confined within certain geographical limits? That the habits and history of several of them differ as widely as those of a hog and a horse? That some attack the potato both in the larva state and in the perfect or winged state; others in the perfect or winged state alone; and others again in the larva state alone? That in the case of eight of these insects there is but one single brood every year, while of the remaining three there are every year from two to three broods, each of them generated by females belonging to the preceding brood? That nine of the eleven feed externally upon the leaves and tenderer stems of the potato, while two of them burrow, like a borer, exclusively in the larger stalks? Finally, that almost every one of these eleven species has its peculiar insect enemies; and that a mode of attack, which will prove very successful against one, two or three of them, will often turn out to be utterly worthless, when employed against the remainder?

THE STALK-BORER—*Gortyna nitela*, Guénée.

(Lepidoptera, Noctuidæ.)

[Fig. 35.]



2

This larva (Fig. 35 2,) is of a livid hue when young, with light stripes along the body, as shown in the figure. When full grown it generally becomes lighter, with the longitudinal lines broader, and at this time it more frequently resembles Figure 36. It commonly burrows in large stalks of the potato; but is not peculiar to that plant, as it occurs also in the stalks of the tomato, and in those of the dahlia and aster and other garden flowers. I have likewise found it boring through the cob of growing Indian corn, and strangely confining itself to that portion of the ear: though it is likewise found occasionally in the stem of that plant. By way of compensation, it is particularly partial to the stem of the common cocklebur (*Xanthium strumarium*); and if it would only confine itself to such noxious weeds as this, it might be considered as a friend instead of an enemy. In 1868 it was more numerous than

[Fig. 36.]

usual, and was particularly abundant along the Iron Mountain and Pacific roads.

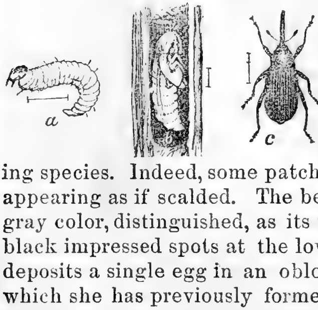
Never having found this worm earlier than June and July, nor obtained the moth from the very earliest matured ones, till the latter part of August and fore part of September, this insect must necessarily be single brooded, the egg requiring longer to hatch, and the larva longer to develop than of many other moths. Leaving the stalk in which they have burrowed the latter part of July, they descend a litte below the surface of the ground and in three days become chrysalids. These are of the normal form, with two fine bristles at the extremity of the body, usually closed so as to form a point, but readily opened V-shaped at the will of the insect, as with hundreds of others of the same class. I have had the moths issue as early as the 30th of August and as late as the 26th of September, and in one instance it emerged during a freezing night, being quite dull and numb at the time, thus showing beyond a doubt that the moths hybernate in a state of torpor, and then deposit their eggs, singly, on the plant destined for the worm, during the months of April and May. This moth (Fig, 35, 2) is of a mouse gray color with the fore wings finely sprinkled with Naples-yellow and having a very faint lilac-colored hue; but distinguished mainly by an arcuated pale line running across their outer third.

Remedy—*Prevention.*—The careful florist, by an occasional close inspection of his plants about the beginning of July, may detect the point at which the borer entered, which is generally quite a distance from the ground, and can then cut him out without injury to the plant. As this is not feasible in a large potato field, care should be taken to prevent his attacks another year as far as it is possible to do so, by hunting for him wherever a vine is seen to suddenly wilt.

THE POTATO STALK-WEEVIL—*Baridius trinotatus*, Say.

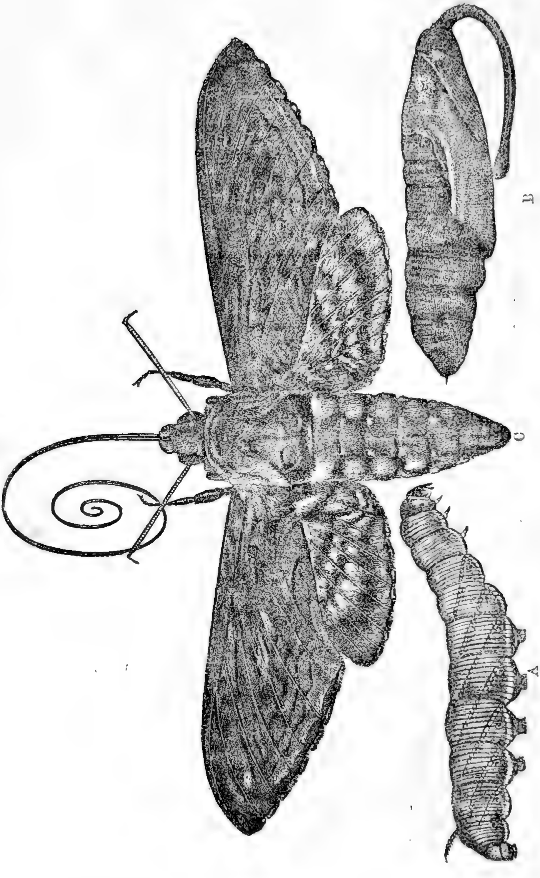
(Coleoptera, Curculionidæ.)

[Fig. 37.]



This insect is more particularly a Southern species, occurring abundantly in the Middle States, but, according to Dr. Harris, being totally unknown in New England. I found it in our own State last summer, equally as abundant as the preceding species. Indeed, some patches were utterly ruined by it, the vines appearing as if scalded. The beetle (Fig 37 *c*) is of a bluish or ash-gray color, distinguished, as its name implies, by having three shiny black impressed spots at the lower edge of the thorax. The female deposits a single egg in an oblong slit about one-eighth inch long, which she has previously formed with her beak in the stalk of the potato. The larva subsequently hatches out, and bores into the heart of the stalk, always, proceeding downwards towards the root. When

[Fig. 38.]



full grown, it is a little over one-fourth inch long (Fig. 37, *a*), and is a soft whitish, legless grub, with a scaly head. Hence it can always be readily distinguished from the larva of the Stalk-borer, which has invariably sixteen legs, no matter how small it may be. Unlike this last insect, it becomes a pupa (Fig. 37, *b*) within the potato stalk which it inhabits; and it comes out in the beetle state about the last of August or the beginning of September. The stalk inhabited by the larva almost always wilts and dies, and this wilting is first noticed in the latitude of St Louis, about the first of July, So far as is at present known it attacks no other plant but the potato, and the perfect beetle, like many other snout-beetles, must of course live through the winter to reproduce its species in the following spring.

REMEDY.—Same as with the foregoing species. Burn all the vines which wilt from its attacks—roots and all, for it almost always works below ground. The Stalk-borer must be *searched* for, if one will be sure of killing him as he *leaves* the stalk to transform; but as this Stalk-weevil transforms within the vine, one may be pretty sure of destroying it by burning the vines when they first wilt.

THE POTATO OR TOMATO-WORM—*Sphinx 5-maculata,* Haw.

(Lepidoptera, Sphingidæ.)

This well known insect, the larva of which is illustrated on the opposite page (Fig. 38, A), is usually called the Potato-worm, but it is far commoner on the closely allied tomato, the foliage of which it often clears off very completely in particular spots in a single night. Many persons are afraid to handle this worm, from an absurd idea that it has the power of stinging with the horn on its tail. But this is a vulgar error and the worm is totally incapable of doing any direct harm to man, either with the conspicuous horn on its tail, or with any hidden weapon that it may have concealed about its person. In fact, this dreadful looking horn is not peculiar to the Potato-worm, but is met with in almost all the larvæ of the large and beautiful group to which it belongs (*Sphinx* family.) It seems to have no special use, but, like the bunch of hair on the breast of the turkey cock, to be a mere ornamental appendage.

When full-fed, which is usually about the last of August, the Potato worm burrows under ground and shortly afterwards transforms into the pupa state (Fig. 38, B). The pupa is often dug up in the spring from ground where tomatoes or potatoes were grown in the preceding season; and most persons that meet with it suppose that the singular, jug-handled appendage at one end of it is its *tail.* In reality, however, it is the *tongue-case*, and contains the long pliable tongue which the future moth will employ in lapping up the nectar of the flowers, before which, in the dusky gloom of some warm, balmy summer's evening, it hangs for a few moments suspended in the air, like the glorified ghost of some departed botanist.

The moth itself (Fig. 38, C) was formerly confounded with the To-

bacco-worm moth (*Sphinx Carolina*, Linnæus), which indeed it very closely resembles, having the same series of orange colored spots on each side of the abdomen. The gray and black markings, however, of the wings differ perceptibly in the two species; and in the Tobacco-worm moth there is always a more or less faint white spot or dot near the centre of the front wing, which is never met with in the other species. In Connecticut and other northern States where tobacco is grown, the Potato-worm often feeds upon the leaves of the tobacco plant, the true Tobacco-worm being unknown in those latitudes. In the more southerly States, on the other hand, and in Mexico and in the West Indies, the true Potato-worm is unknown, and it is the Tobacco-worm that the tobacco growers have to fight. While in the intermediate country both species may frequently be captured on the wing in the same garden and upon the same evening. In other words, the Potato-worm is a northern species, the Tobacco-worm a southern species; but on the confines of the two districts exclusively inhabited by each, they intermingle in varying proportions, according to the latitude.

Remedies.—This insect is so large and conspicuous that the most effectual mode of destroying it is by hand-picking. In destroying the worms in this manner care should be taken to leave alone all those specimens which one finds covered with little white oval cocoons, as these are the cocoons of little parasites* which materially assist us in its subjugation.

THE STRIPED BLISTER-BEETLE—*Lytta vittata*, Fabr.

(Coleoptera Meloïdæ.)

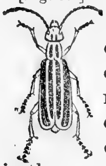
The three insects figured and described above infest the potato plant in the larva state only, the two first of them burrowing internally in the stalk or stem, the third feeding upon its leaves externally. Of these three the first and third are moths or scaly-winged insects (order *Lepidoptera*), so called because the wings of all the insects belonging to this large group are covered with minute variously-colored scales, which, on the slightest touch, rub off and rob the wing of all its brilliant coloring. The second of the three, as well as the next four foes of the potato, which I shall notice, are all of them beetles or shelly-winged insects (order *Coleoptera*), so called because what would normally be the front wing is transformed here into a more or less hard and shelly wing-case, which, instead of being used as an organ of flight, is employed merely to protect and cover the hind wings in repose. To look at any beetle, indeed, almost any inexperienced person would suppose that it has got no wings at all; but in reality nearly all beetles have full sized wings snugly folded up under their wing-cases, and, whenever they choose it, can fly with the greatest

* There are two distinct parasites which attack this worm, both species being very much of a size. One issues from the worm and spins a *smooth* white silken cocoon which it fastens by one end to the skin of the worm, and in due time produces a fly which Mr. Norton informs me is an undescribed species of *Blacus*, West. (*Braconides polymorphi*). The other species forms an immense mass of loose woolly cocoons and produces an apparently undescribed species of *Microgaster*.

ease. This is the case with the four following beetles which infest the potato. As these four species all agree with one another in living under ground and feeding upon various roots, during the larva state, and in emerging to attack the foliage of the potato, only when in the course of the summer they have passed into the perfect or beetle state; it will be quite unnecessary to repeat this statement under the head of each of the four. In fact, the four are so closely allied, that they all belong to the same family of beetles, the blister-beetles (*Lytta* family)—to which also the common imported Spanish-fly or blister-beetle of the druggist appertains—and all of them will raise just as good a blister as that does, and are equally poisonous when taken internally in large doses. In Missouri, these blister-beetles were more numerous and more injurious in 1868 than the dreaded Colorado Potato-beetle.

The Striped Blister-beetle (Fig. 39) is almost exclusively a southern species, occurring in particular years very abundantly on the potato vine in Central and Southern Illinois, and in our own State, though according to Dr. Harris, it is also occasionally found even in New England. In some specimens, the broad outer black stripe on the wing-cases is divided lengthways by a slender yellow line, so that instead of *two* there are *three* black stripes on each wing-case; and in the same field all the intermediate grades between the two varieties may be met with; thus proving that the four-striped individuals do not form a distinct species, as was formerly supposed by the European entomologist, Fabricius, but are mere varieties of the same species to which the six-striped individuals appertain.

[Fig. 39.]



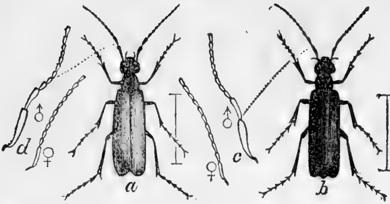
The late Samuel P. Boardman, of Lincoln, Illinois, discovered that this Striped Blister-beetle, like the Colorado beetle, eats all other potato tops in preference to Peach-blows. (See *N. Y. Sem. Tribune*, July 13, 1868.) This is certainly a new fact, so far as regards the former species, though it has long been ascertained to be true of the latter, but as I shall presently show, the Margined Blister-beetle has the same tastes.

THE ASH-GRAY BLISTER-BEETLE*—*Lytta cinerea*, Fabr.

This species (Fig. 40 *a*, male) is the one commonly found in the more northerly parts of the Northern States, where it usually takes the place of the Striped Blister-beetle figured above. It is of a uniform ash-gray color; but this color is given it by the presence upon

* In the male of this species, but not in the female, the first two joints of the antennæ are greatly elongated and dilated; which is also the case with the species next to be referred to. (Fig. 40 *d*, represents the male antennæ, above; that of female below.) Hence, in splitting up the extensive and unwieldy old genus (*Lytta*), these and certain allied species have been very properly placed in a genus by themselves (*Macrobasis*); while the Striped Blister-beetle and the Margined Blister-beetle, not possessing this peculiarity, are grouped together under a distinct genus (*Epicauta*). Practical men, however, who do not desire to trouble their heads with these niceties, will find it most convenient to class them all together under the old genus (*Lytta*); and this we have accordingly done.

[Fig. 40.]



its body of minute ash-gray scales or short hairs, and whenever these are rubbed off, which happens almost as readily as on the wings of a butterfly, the original black color of its hide appears. It attacks not only potato vines, but also honey-locusts, and especially the English or Windsor bean, and I found it quite abundant on the Early Snap bean at Hermann, last summer. It also attacks the foliage of the apple-tree, and likewise gnaws into the young fruit.

THE BLACK-RAT BLISTER-BEETLE—*Lytta murina*, Le Conte.

This species (Fig. 40 *b*, male) is sometimes found upon the potato in the month of July, and early in August. In 1867 it was found by Mr. D. W. Kauffman, to swarm on the potato vines near Des Moines, Iowa; but I have not yet met with it in Missouri.

THE BLACK BLISTER-BEETLE—*Lytta atrata*, Fabr.

This species is very similar in appearance to the Black-rat Blister-beetle; the latter being distinguishable from it only by having four raised lines placed lengthwise upon each wing-case and by the two first joints of the antennæ being greatly dilated and lengthened in the males as shown at Figure *c*. The Black Blister-beetle appears in August and September, and is very common on the flowers of the Golden-rod. I learned from several parties, while attending the October meeting of the Meramac Horticultural Society, at Eureka, that it had been quite numerous on the potatoes in that vicinity, and that they did much damage in some patches. The severe drouth of the summer had retarded the development of the tubers, so that this beetle attacked the vines before the latter were formed; but as a general rule, it makes its appearance too late in the season to do great damage.

THE MARGINED BLISTER-BEETLE*—*Lytta marginata*, Fabr.

[Fig. 41.]

This species (Fig. 41) may be at once recognized by its general black color, and the narrow ash-gray edging to its wing-cases. It usually feeds on certain wild plants; but I found it quite abundant on potatoes last summer, both in our own State and in Illinois. It appears not to attack the Peach Blow variety, for Mr. Wm. Brown, of Eureka. informs me that he had a patch of Quaker Russetts by the side of another patch of Peach Blows, and while the former were entirely eaten up by it, the latter were untouched.

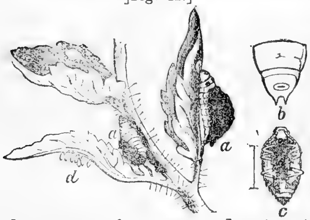
* This is the name formerly given by almost all entomologists to this species; and a most appropriate one it is, in view of the remarkable ash-gray margin of its black wing-cases (*elytra*). But of late years it has been discovered, that, as long ago as the middle of the last century, and several

REMEDIES.—The same remedies will apply equally to all five of the Blister-beetles that have just been described. Let it be remembered that during the heat of the day, these beetles are ready with their wings and may be driven from the vines. Thus the most practical and efficient mode of destroying them, is to drive them into a windrow of hay or straw, and kill them by setting fire to it. As they all appear rather late in the season, I should recommend the planting of early varieties, which will be more likely to escape their attacks; and especially of the Peach Blow variety, the leaves of which seem to be more distasteful to them than those of any other variety.

THE THREE-LINED LEAF-BEETLE—*Lema trilineata*, Olivier.—(Coleoptera, Chrysomelidæ.)

The three first insects, described and figured above as infesting the potato-plant, attack it only in the larva state. The five next, namely the five Blister-beetles, attack it exclusively in the perfect state. The three that remain to be considered attack it both in the larva and in the perfect state, but go underground to pass into the pupa state, in which state—like all other Beetles, without exception—they are quiescent, and eat nothing at all.

[Fig. 42.]



The larva of the Three-lined Leaf-beetle may be distinguished from all other insects that prey upon the potato by its habit of covering itself with its own excrement. In Figure 42 *a*, this larva is shown in profile, both full and half grown, covered with the soft, greenish excrementitious matter which from time to time it discharges. Figure 42 *c*, gives a somewhat magnified view of the pupa; and Figure 42 *b*, shows the last few joints of the abdomen of the larva, magnified, and viewed, not in profile, but from above. The vent of the larva, as will be seen from this last figure, is situated on the upper surface of the last joint, so that its excrement naturally falls upon its back, and by successive discharges is pushed forward towards its head, till the whole

years before Fabricius named and described this insect as the "Margined Blister-Beetle" (*Lytta marginata*), it was named and described as the "Ash-gray Blister-beetle" (*Lytta cinerea*), by Foerster. Hence, in accordance with the inexorable "law of priority," the obedient scientific world has been called upon to adopt Foerster's name for this species; and as two species belonging to the same genus can not, of course, have the same specific name, the true Ash-gray Blister-beetle of Fabricius (*Lytta cinerea*), which is really ash-gray all over, has been re-christened by the name of "Fabricius' Blister-beetle" (*Lytta Fabricii.*) Positively, this continual chopping and changing in scientific nomenclature is getting to be an unbearable nuisance, and must be put a stop to. Otherwise one-half of the time of every entomologist, which might be much better occupied in studying out scientific *facts*, will be frittered away in studying out scientific *phrases*.

Many writers, in giving the scientific designation of an insect, neglect to add the name of the author who first described it. This practice often leads to error, uncertainty, and confusion, as the preceding example will at once show. If, for instance, we write simply "*Lytta cinerea*," how can the reader tell whether we mean the species described under that name by Foerster, or the very distinct species described under the very same name "*cinerea*" by Fabricius? Whereas, if we add the author's name, all doubts upon the subject are at once removed; and we can snap our fingers at those wearisome and interminable disputes about the priority of names and the law of priority, which take up so much space in scientific papers, while they add absolutely nothing to our knowledge of the facts recorded by the finger of God in the great book of Nature.

upper surface of the insect is covered with it. In other insects, which do not indulge in this singular practice, the vent is situated either at the extreme tip of the abdomen or on its lower surface.

There are several other larvæ, feeding upon other plants, which commonly wear cloaks of this strange material, among which may be mentioned one which is very common upon the Sumach, and which produces a jumping, oval Leaf-beetle (*Blepharida rhois*, Foerster), about a quarter of an inch long, and of a yellow color, speckled with brick-red. The larvæ of certain Tortoise-beetles (*Cassida*), some of which feed on the Morning Glory and the Sweet Potato vines, adopt the same practice, but in their case there is a forked process at the tail which curves over their backs and receives the requisite supply of excrement.

Many authors have supposed that the object of the larva, in all these cases, is to protect its soft and tender body from the heat of the sun. This can scarcely be the correct explanation, because then they would throw away their parasols in cold cloudy weather, which they do not do. In all probability, the real aim of Nature, in the case of all these larvæ, is to defend them from the attacks of birds and of cannibal and parasitic insects.

There are two broods of this species every year. The first brood of larvæ may be found on the potato vine toward the latter end of June, and the second in August. The first brood stays underground about a fortnight before it emerges in the perfect beetle state; and the second brood stays there all winter, and only emerges at the beginning of the following June. The perfect beetle (Fig. 43) is of a pale yellow color, with three black stripes on its back, and bears a general resemblance to the common Cucumber-beetle (*Diabrotica vittata*, Fabr., Fig 44). From this last species, however, it may be readily distinguished by the remarkable pinching in of the sides of its thorax, so as to make quite a lady-like waist there, or what naturalists call a "constriction." It is also on the average a somewhat larger insect, and differs in other less obvious respects. As in the case of the Colorado Potato-beetle, the female, after coupling in the usual manner, lays her yellow eggs (Fig. 42 *d*) on the under surface of the leaves of the potato plant. The larvæ hatching from these require about the same time to develop, and when full grown descend in the same manner into the ground, where they transform to pupæ (Fig. 42 *c*) within a small oval chamber, from which in time the perfect beetle comes forth.

[Fig. 43.]

[Fig. 44.]

The Three-lined Leaf-beetle, in certain seasons, is a great pest in the Eastern States; but, it has never yet occurred in the Valley of the Mississippi in such numbers as to be materially injurious.

THE CUCUMBER FLEA-BEETLE—*Haltica cucumeris.**—Harris.

(Coleoptera, Chrysomelidæ.)

[Fig. 45.]

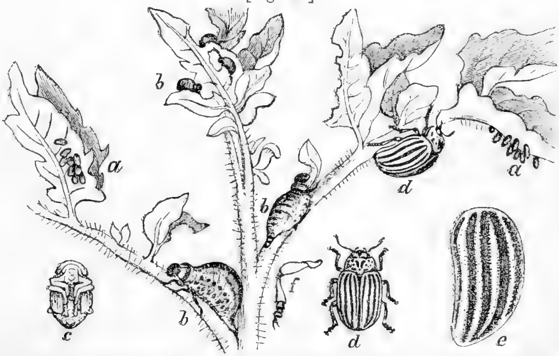
This minute Beetle (Fig. 45) belongs to the Flea-beetles (*Haltica* family), the same sub-group of the Leaf-beetles (*Phytophaga*) to which also appertains the notorious Steel-blue Flea-beetle (*Haltica chalybea*, Illiger), that is such a pest to the vineyardist. Like all the rest of the Flea-beetles, it has its hind thighs greatly enlarged, which enables it to jump with much agility. It is not peculiar to the potato, but infests a great variety of plants, including the cucumber, from which it derives its name. It operates by eating minute round holes into the substance of the leaf which it attacks, but often not so as to penetrate entirely through it. In South Illinois whole fields of potatoes may often be observed looking seared and yellow, and with their leaves riddled with the round holes made by this insect. The larva feeds internally upon the substance of the leaf, like that of the closely-allied European Flea-beetle of the turnip (*Haltica nemorum*, Linn.); and, from its near relationship to that insect, we may infer that it goes underground to assume the pupa state, that it passes through all its stages in about a month, and that there are two or three broods of them in the course of the same season.

THE COLORADO POTATO-BEETLE—*Doryphora 10-lineata*, Say.

(Coleoptera, Chrysomelidæ.)

ITS PAST HISTORY AND FUTURE PROGRESS.

[Fig. 46.]



Up to the autumn of 1865, it was generally supposed by economic entomologists, that this destructive insect had existed from time immemorial in the Northwestern States, feeding upon some worthless weed or other; and that of late years, from some unexplained cause, it had all of a sudden taken to attacking the potato-plant. In October, 1865,

* Erroneously considered by some authors as identical with the *Haltica pubescens* of Illiger. In this last species, according to Dr. J. L. LeConte, the thorax, instead of being shining, as in our insect, is opaque, with large, dense punctures.

Mr. Walsh showed that originally its exclusive home was in the Rocky Mountains, where it had been known to exist for at least forty-five years feeding upon a wild species of potato peculiar to that region (*Solanum rostratum*, Dunal); that when civilization marched up to the Rocky Mountains, and potatoes began to be grown in that region, it gradually acquired the habit of feeding upon the cultivated potato; that in 1859, spreading eastward from potato patch to potato patch, it had reached a point one hundred miles to the west of Omaha city, in Nebraska; that in 1861, it invaded Iowa, gradually, in the next three or four years, spreading eastward over that State; that in 1864 and 1865, it crossed the Mississippi, invading Illinois on the western borders of that State, from the eastern borders of North Missouri and Iowa, upon at least five different points on a line of two hundred miles; and that in all probability it would in future years "travel onwards to the Atlantic, establishing a permanent colony wherever it goes, and pushing eastward at the rate of about fifty miles a year." (*Practical Entomologist*, Vol. I, No. 1.) A remarkable peculiarity in the eastern progress of this insect was subsequently pointed out by the same writer, in 1866, namely, that "in marching through Illinois in many separate columns, just as Sherman marched to the sea, the southern columns of the grand army lagged far behind the northern columns." (*Ibid*, II, p. 14.)

Now, let us see how far the predictions above, have been verified By the autumn of 1866, the Colorado Potato-beetle, which appears to have invaded the south-west corner of Wisconsin at as early a date as 1862 (*Ibid*, II, p. 101), had already occupied and possessed a large part of the cultivated or southern parts of that State; and in Illinois if we draw a straight line to connect Chicago with St. Louis, nearly all the region that lies to the north-west of that line was overrun by it. It subsequently invaded parts of South Illinois, occurring in Union, Marion, and Effingham counties, in 1868; and already in 1867 it had passed through the eastern borders of North and Central Illinois into Western Indiana, and the south-west corner of Michigan; and finally, in 1868 it made its appearance in many different places in Indiana, and as the following communication from a Cincinnati correspondent of the *Ohio Farmer*, under date of July, 1868, will show, it has even spread into Ohio.

"About three years ago when in your office at Cleveland, you presented me with samples of this devastating insect, the first I had seen; they have been preserved in the collection of one of the best entomologists of Ohio. You had received the beetles from some correspondent in Iowa, where it was then ravaging the crops and where it continues to be very destructive. We soon learned that the insects were progressing eastward at the computed rate of about thirty miles a year, and we began to calculate the time when we might expect its appearance in Ohio—which we did not anticipate for some years.

"Having crossed the Mississippi at Rock Island the insects soon traversed the State of Illinois and reached the shores of Lake Michigan, where it might have met a watery grave, but, unfortunately its course was only deflected southward, and there were other cohosts of the invaders, traversing lower parallels, so that by convergence, the force was multiplied and great fears were anticipated by the potato-growers of Northern Indiana and Ohio, and it was supposed that Northern Ohio would be invaded before the Southern portion of this State.

"At the last annual meeting of the Indiana Horticultural Society, in January 1868, the existence of this insect was reported in several counties in the north-western part of that State during 1867, leading us to apprehend that the day of their approach to us was not so distant as we had fondly hoped. Correspondents now inform us that this beetle has reached Lafayette, Indianapolis, Danville, and other points of central Indiana, so that its progress eastward continues with increasing speed.

"We have now to record the actual presence of the Ten-lined Spearman, (*Doryphora* 10-*lineata*,) in the south-western corner of Ohio, a very few specimens of this pest having been taken within the past week in Hamilton county."

Thus it appears that its average annual progress towards the east has been upwards of seventy miles. At the same rate of progression it will touch the Atlantic ocean in about ten years from now, or A. D. 1878.

"But," it will be asked, "how could any entomologists make the mistake of supposing that the Colorado Potato-beetle had always existed in the Northwestern States?" The answer is, that, as was proved three years ago in the article already referred to they inadvertently confounded together two entirely distinct, but very closely allied species, the bogus Colorado Potato-beetle (*Doryphora juncta*, Germar), and the true Colorado Potato-beetle (*Doryphora* 10-*lineata*, Say). The former of these has existed in the South-west from time immemorial, and has long since been known to feed in the larva state upon the horse-nettle (*Solanum carolinense*, Linn,) a wild plant which is exceedingly adundant in our own State. In 1863 Mr. Glover stated that he "had found an insect similar to the Ten-striped Spearman [or true Colorado Potato-beetle] on the common horse-neetle in Georgia." (*Agr. Department Rep.*, p. 579). In 1867 he assured me that this insect, found by him on the horse-nettle in Georgia four years before, was the bogus Colorado Potato-beetle (*D. juncta*,) and that "a Mr. Walter had also found it feeding upon the Egg-plant in Montgomery, Alabama." I discovered this same species in Kentucky in 1864, feeding in conjunction with its larvæ upon a plant, which could have been nothing else but the horse-nettle; and last fall I met with it in great numbers, in St. Louis and Jefferson counties in this State, feeding upon the same plant, in company with its larvæ; and in one in-

stance the larvæ of both the true and the bogus species occurred in company. Thus it appears to inhabit at least five southerly regions, namely South Illinois, Missouri, Kentucky, Georgia and Alabama.

The true Colorado Potato-beetle as has been already stated, only immigrated into Illinois in 1864, and in its native home, the Rocky Mountains, feeds naturally upon another wild species of potato, which is quite distinct from the horse-nettle, and is peculiar to the Rocky Mountain region. Again, the former species has never yet been known to attack the cultivated potato, and in all likelihood never will do so; for, as it has existed in all likelihood never will do so; for, as it has existed in Illinois, for at least 14 years, and in Georgia for at least 44 years, without ever having been known to attack this plant, which has been growing all that time in these two States, it is not at all probable that it will do so at any future time. The latter species, on the other hand, acquired this habit, as was shown before, in the region of the Rocky Mountains, when for the first time the potato was introduced there, some twenty years ago; and from that region the potato-feeding race of this insect has since been spreading further and further every year towards the east. Finally the bogus Colorado Potato-beetle is more peculiarly a southern species, occurring in the more southerly portion of Illinois, and in Missouri, Kentucky, Georgia, and probably Alabama, while the true Colorado Potato-beetle is originally an Alpine species, its native home being the canons (kanyons) of the Rocky Mountains, and it therefore thrives best and spreads fastest in the more northerly regions, such as Nebraska, Iowa, Minnesota, Wisconsin and North Illinois; while in South Illinois, Missouri, and Kansas, it neither thrives so well nor spreads so rapidly.

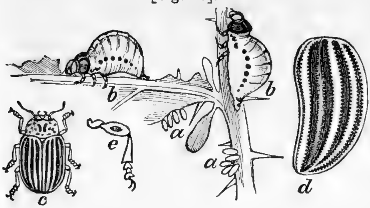
The question whether the true Colorado Potato-beetle has existed for an indefinitely long time in the country that lies to the east of the Mississippi river, or whether it is not the bogus Colorado Potato-beetle that has there been mistaken for it, while the true Colorado Potato-beetle has in reality immigrated into that country from the Rocky Mountain region within the last four or five years, may seem to some of merely theoretical interest. It is, however, of great practical importance. On the first supposition it is not probable that this bitter enemy of the potato will travel onwards and onwards towards the Atlantic; on the second supposition it will most likely traverse Ohio within a year or two, spread like a devouring flame through the great potato-growing State of Michigan, and finally pass eastwards into Pennsylvania, New York, and New England. I shall, therefore, briefly point out the minute but invariable characters which distinguish them both in the larva and perfect beetle states.

I had an excellent opportunity of comparing the larvæ of *juncta* with those of *10-lineata*, from alcoholic specimens which were kindly sent to Mr. Walsh by Mrs. H. C. Freeman, of Cobden, Illinois, and from numerous living specimens which I found around St. Louis.

At Figure 46, the true Colorado Potato-beetle is represented in all

its varied stages; *b*, *b*, *b* representing the larvæ of three different growths and sizes. In the annexed Figure 47, *b*, *b*, represents the full grown larvæ of the bogus Colorado Potato-beetle. It will be seen at once that the head of the former is black, that the first joint behind the head is pale and edged with black behind only, that there is a double row of black spots along the side of the body, and that the legs are black, the ground-color of the body being of a Venetian-red. In the other larva (Fig. 47 *b*), on the contrary, the head is of a pale color, the first joint behind the head reddish-brown and edged all round with black; there is but a single row of black spots along the side of the body and the legs are pale, while the ground color of the body is of a pale cream, tinged with pink or flesh color. Such are the distinguishing characteristics of the two larvæ; but it is an interesting fact that these characters are not always constant. Thus the individuals of the second (last summer's) brood of 10-*lineata* larvæ which fed on the horse-nettle in my garden were all of them much paler than were those of the first, potato feeding brood, from which they had descended; and furthermore the lower row of spots was very indistinct and in many entirely obsolete, while the head, instead of being black was entirely brown. Whether this variation from the normal type was due to the food-plant or not, I shall not at present offer an opinion, but I should have been doubtful about the species had I not bred the perfect beetle (10-*lineata*) from them. Again as I shall immediately show the young larva of *juncta* similates in its markings the mature larva of 10-*lineata*.

[Fig. 47].



The eggs of 10-*lineata* (Fig. 46, *a*, *a*) are of a translucent orange-red color, while those of *juncta* (Fig. 47, *a*, *a*) are whitish, with a faint tinge of flesh-color, and still more translucent. The newly hatched larvæ of the former are of a dark Venetian-red, and they become lighter as they grow older, while the newly hatched larvæ of the latter have the body as light as the full grown individuals. Singularly enough, however, the newly hatched larvæ of *juncta* instead of having the light yellow head and the single row of spots of the mature individuals, have a brown head and *two* rows of spots, the lower being less distinct than the upper row, and placed exactly in the same position as the lower row on the *mature* larvæ of 10-*lineata* (see Fig. 46 *b*, lower figure).

I subjoin a more full description of *Doryphora juncta*. That of the larva of *Doryphora* 10-*lineata* will be found in Dr. Fitch's *N. Y. Reports*, Vol. III, pp. 231–2. According to Dr. Fitch, the ground color of this last larva is "pale-yellow" in the mature state; according to Dr. Shimer, in his excellent article on the preparatory stages of this insect, it is "orange." In the immature larvæ it is almost always of a dull Venetian-red, though in the mature larvæ the color becomes

lighter. Indeed in some instances it becomes almost as pale as that of *D. juncta.* I saw a number of such pale individuals among the late broods of last summer, though I had never seen them so pale before, notwithstanding I have witnessed great numbers of them every year, since 1863.

DORYPHORA JUNCTA, Germar.—*Mature larva.*—General color a pale yellowish flesh-color. Head bright gamboge-yellow, with the antennæ placed behind the base of the mandibles, short and very robustly conical, three-jointed, joints 2 and 3 black. Precisely as in 10-*lineata,* there are six small simple black eyes upon each side, one pair longitudinally arranged and placed below the antenna, the other two pairs arranged in a square and placed a little above and behind the antenna; tip of the mandibles black. Body, with the dorsum of joint 1 composed of a separate transverse horny plate, rounded at the sides, of a rich shiny vandyke-brown, with the edges somewhat raised, and jet black and with a fine line of a lighter color running through the middle from the posterior to the anterior edge. Joints 1—3 each, with a lateral horny black tubercle, that of joint 1 placed below and behind the horny prothoracic plate, and enclosing a spiracle. Joints 4—11 each with a similar lateral tubercle enclosing a spiracle; but the row composed of these eight tubercles is placed a little above the row of three tubercles on joints 1—3, and the last four of the eight are gradually smaller and smaller, until that on joint 8 is reduced to a simple black spiracle. Legs pale yellow; coxæ exteriorly dark brown, the two hinder pairs each more and more so, with a geminate horny plate above each, which becomes more and more brown in each successive pair. An exterior dusky dot, or small spot, on the tip of the femur and of the tibia. Tarsus small, one-jointed, brown, and with a black claw.

The body has a distinct translucent dorsal heart-line, and has usually a shade of the same color both above and below the lateral row of black tubercles; while there are two transverse dark-brown bands across the extreme tip of the body, which is used as an anal proleg. This larva, when well fed, is very smooth and swollen, though it soon becomes wrinkled after fasting. The pink tint of the body is more intense on the neck and between the legs.

Now let us see what are the differences in the perfect beetle state of these two insects, in which state even a practised entomologist would, at first sight, be apt to confound them together. Indeed, so minute are the differences, that in a drawing of the natural size, it is scarcely possible to exhibit them, but with the greatly enlarged leg and wing-case of each species, which are given in the foregoing figures, we shall readily be enabled to do so. Figure 46, *d, d,* exhibits the true Colorado Potato-beetle; Figure 47, *c,* the bogus Colorado Potato-beetle, each of its natural size. Figure 46, *e,* shows the *left* wing-case enlarged, and Figure 46, *f,* an enlarged leg of the former; Figure 47, *a,* the *left* wing-case enlarged, and Figure 47, *e,* an enlarged leg of the latter. On a close inspection it will be perceived that in the former (Fig. 46, *e*) the boundary of each dark stripe on the wing-cases, especially towards the middle, is studded with confused and irregular punctures, partly inside and partly outside the edge of the dark stripe; that it is the third and fourth dark stripes, counting from the outside, that are united behind; and that in the leg both the knees and the feet are black. In the latter (Fig. 47, *d*), on the contrary, the dark stripes are accurately edged by a single regular row of punctures placed in a groove (*stria*); it is the second and third stripes—not the third and fourth—counting from the outside, that are united behind, the space between them being almost always brown; and the leg is entirely pale, except a black spot on the middle of the front of the thigh.

The spots on the thorax, in either of the above two species, are normally eighteen in number, arranged in the same very peculiar pattern which may be seen both in Figure 46, *d, d,* and in Figure 47, *c*; and precisely the same variations in this complicated pattern occur in either species.

Thus, these two beetles differ essentially from one another upon a strict comparison; but the general resemblance is so great that it is not to be wondered at that the two have been confounded together by several otherwise well qualified observers.

Habits of the Colorado Potato-beetle.—This insect *can* fly, though it does so very reluctantly and only during the heat of the day. Its wings, like those of several allied species, are of a bright rose-color, and with its cream-colored body, and the five black stripes upon each wing-case, it presents a beautiful appearance as it flies abroad in the clear light of the sun. Its transformations were first made known by myself in the *Prairie Farmer* for August 8, 1863. Subsequently, in 1866, Dr. Shimer, of Mt. Carroll, detailed some additional particulars bearing on its habits, in a paper which he published in the *Practical Entomologist* (vol. 1, pp. 84–85). In the latitude of St. Louis there are three broods during the year, the last brood wintering over in the beetle state underground. They are usually dug up in the spring of the year in land that had been planted to potatoes the year before. The beetles issue of their own accord from the ground about the first of May, and the last brood of beetles enters the ground to hybernate during the month of October. Though, in general terms, this beetle may be said to be three-brooded, yet it may be found at almost any time of the year in all its different stages. This is owing to the fact that the female continues to deposit her eggs in patches from time to time—covering a period of about forty days; and also from the fact that among those larvæ which all hatch out in one day, some will develop and become beetles a week and even ten days earlier than others. Thus it may be that some of the late individuals of the third brood pass the winter in the pupa state, though the normal habit is to first transform to beetles. Each female is capable of depositing upwards of a thousand eggs before she becomes barren, and in from thirty to forty days from the time they were deposited, they will have produced perfect beetles. These beetles are again capable of depositing eggs in about two weeks after issuing from the ground, and thus, in about fifty days after the egg is laid, the offspring begins to propagate. The pupa of the Colorado Potato beetle is represented at Figure 46, *c*. It is formed in a little cavity which the larva had made perfectly smooth and hard, and it is of the same color as the larva. The beetle, on first emerging from it, is quite pale and soft, without any markings whatever.

Unlike many other noxious insects, this larva is not a general feeder, but is confined to plants belonging to the potato family (*Solanaceæ*), and especially to the genus to which the potato belongs (*Solanum*). Occasionally it feeds on the tomato, on the ground-cherry (*Physalis*), and on the imported Jamestown-weed, or gympson-weed (*Datura*). It prefers the horse-nettle (*Solanum carolinense*) to some varieties of the potato, and were it not that the nettle is considered a nuisance, on account of the difficulty of eradicating it when

once introduced, it would be a good plan to encircle a potato field with a row of nettles, so as to concentrate the insects, and thus more readily destroy them. It is also even more destructive to the egg-plant than to the potato. Now, the egg-plant, the horse-nettle, and the potato, all three of them belong to the same genus (*Solanum*), as the wild plant upon which the larva originally fed in the Rocky Mountain region; but the egg-plant and the horse-nettle are botanically more closely related to the last than is the potato; being, like the Rocky Mountain potato, covered with thorny prickles, while the cultivated potato is perfectly smooth. On the other hand, the cultivated potato is much more nearly related to the Rocky Mountain species than is the tomato; which last has, by modern botanists, been removed from the genus to which the other two appertain, and placed in a genus by itself. It would seem, therefore, that the closer a plant comes to the natural food-plant of the insect, the better the insect likes it.

The beetles have been sent to me, as taken from other plants, and even from the raspberry, but I could never succeed in making them feed on any plant that did not belong to the potato family, though I am informed by my friend, Edgar Sanders, of Chicago, that they greedily attack the tubers after they are dug, and he has found as many as six in a single potato.

It is undoubtedly a most singular and noteworthy fact that, out of two such very closely allied species as the bogus and the true Colorado Potato-beetles, feeding respectively in the first instance upon very closely allied species of wild potato (*Solanum rostratum* and *S. carolinense*), the former should have pertinaciously refused, for about half a century, to acquire a taste for the cultivated potato, with which it was all the time in the closest and most immediate contact, while the latter acquired that taste as soon as ever it was brought into contact with that plant. But, after all, this is not so anomalous and inexplicable as the fact that the Apple-maggot Fly (*Trypeta pomonella*, Walsh), which exists both in Illinois, New York, and New England, and the larva of which feeds in Illinois upon the native haws, and has never once been noticed to attack the imported apple there, should, within the last few years, have suddency fallen upon the apple, both in New York and New England, and in many localities there, have become a more grievous foe to that fruit than even the imported Apple-worm (*Carpocapsa pomonella*, Linn.)*

Thinking that the bogus Colorado Potato-beetle might be compelled to feed on the potato in a state of confinement, I gave it every opportunity; but though the larvæ, when transferred from the horse nettle, fed more or less on potato leaves, they invariably became sickly and eventually died. But even if they had actually fed upon potato leaves quite freely in a state of confinement and developed into bee-

* See on this subject the First Annual Report on the Noxious Insects of Illinois, by Benj. D. Walsh, pp. 29-30, in the Transactions of the Illinois State Horticultural Society for 1867.

tles it by no means follows that the mother beetle would deposit her eggs upon the potato in a state of nature, and thereby compel her future progeny to feed upon that plant. That she will do so upon her natural food-plant, the horse-nettle, we know; and, according to Mr. Walter of Alabama, she will do so upon the egg-plant, which is thorny like the horse-nettle. But apparently she is indisposed to go one step further, and lay her eggs upon a smooth species of the same botanical genus, namely the potato.

NATURAL REMEDIES.—Persons not familiar with the economy of insects are continually broaching the idea that, because the Colorado Potato-beetle is in certain seasons comparatively quite scarce, therefore it is about to disappear and trouble them no more. This is a very fallacious mode of reasoning. There are many insects—for instance, the notorious Army-worm of the north (*Leucania unipuncta*, Haworth)—which only appear in noticeable numbers in particular years, though there are enough of them left over from the crop of every year to keep up the breed for the succeeding year. There are other insects—for instance the Canker-worm (*Anisopteryx vernata*, Peck)—which ordinarily occur in about the same numbers for a series of years, and then, in a particular season and in a particular locality, seem to be all at once swept from off the face of the earth. These phenomena are due to several different causes, but principally to the variation and irregularity in the action of cannibal and parasitic insects. We are apt to forget that the system of Nature is a very complicated one—parasite preying upon parasite, cannibal upon cannibal, parasite upon cannibal, and cannibal upon parasite—till there are often so many links in the chain that an occasional irregularity becomes almost inevitable. Every collector of insects knows, that scarcely a single season elapses in which several insects, that are ordinarily quite rare, are not met with in prodigious abundance; and this remark applies, not only to the plant-feeding species, but also to the cannibals and the parasites. Now, it must be quite evident that if, in a particular season, the enemies of a particular plant-feeder are unusually abundant the plant-feeder will be greatly diminished in numbers, and will not be able to expand to its ordinary proportions until the check that has hitherto controlled it is weakened in force. The same rule will hold with the enemies that prey upon the plant-feeders, and also with the ememies that prey upon those enemies, and so on *ad infinitum*. The real wonder is, not that there should be occasional irregularities in the numbers of particular species of insects from year to year, but that upon the whole the scheme of creation should be so admirably dove-tailed and fitted together, that tens of thousands of distinct species of animals and plants are able permanently to hold their ground, year after year, upon a tract of land no larger than an ordinary State.

To illustrate the decrease in its numbers which took place in the State of Iowa from 1867–8, I will state that Mr. Henry Tilden, of Da-

venport, who had previously made tomato and potato growing a specialty, was forced to go to raising small grains on its account, in 1867, having lost 30 acres of potatoes by its ravages in 1866; while in 1867 Mr Suel Foster, of Muscatine, Iowa, offered a large premium to any one who would insure his crop of potatoes. Now I have received numbers of letters which go to show that the damage done to potatoes in Iowa in 1868 was comparatively very slight, and the following article which Mr. Foster published in the *Prairie Farmer* of May 16th 1868, sufficiently demonstrates that Mr. F. would have been the loser, had any insurance company seen fit to insure his crop on his own terms:

"For three years past I have given the most discouraging accounts of the ruinous destruction of our almost indispensable potato crop. I now have a word of encouragement. Last year I planted very sparingly of potatoes; the year before, by great perseverance, I succeeded in raising a few Early Goodrich and Harrison, by continual picking and killing the bugs, and last year planted the product on a new piece of land where no potatoes had been raised; but the bugs found them as soon as they were up; I picked the bugs awhile, then gave them up to their destruction, and the potatoes were nearly destroyed. About the first to the tenth of June the bugs began to diminish. We found the little red and black spotted lady bug quite numerous and active, eating the eggs of the potato bug. I didn't believe those little lady bugs could possibly destroy enough of the eggs of the potato bugs to materially check their increase; but there were but very few of the second brood that hatched in this part of the country, and our late and strong growing potatoes were a full crop.

"What became of the bugs that were so numerous in May and the first of June? The lady bug, with a little assistance from a few other insects, destroyed their eggs. Last May the weather was very wet and cold, yet the bugs increased, and although more stiff and clumsy than in dry, warm weather, they were hearty at their food. Had June been cold and wet, I should have thought their disappearance was caused by that; but June was a very favorable time for their increase and spread on the wing by night. The Colorado potato bugs nearly all disappeared here in June, and not a bug have we seen in plowing and digging in the ground this spring, while in former seasons we used to find them plentifully. I believe some will make their appearance this year, but I fully believe that the same cause which destroyed them so early last year—the lady bug and others, some of which preyed upon the young potato bugs—will prevent their increase this year. If the above are not the facts in this case, can any one tell us facts and theories that are more reliable? It is true, I am not as positive about this as if I had met a regiment of rebels, and had counted the dead and prisoners, to tell what had become of them. But we, in this region, do not expect the bug this year, and are planting potatoes with very little hesitation. Your readers may rely upon

this as the fate of the potato bug for the present, and I will write you again in a month, or as soon as I get additional news from him.

"The Illinois correspondent of the *Country Gentleman*, writing from Champaign county, says:

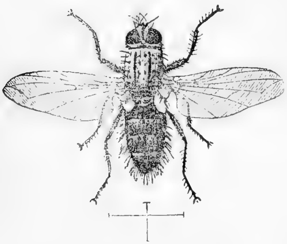
"Those plowing old potato ground where these creatures operated extensively last year, find the ground full of the dormant wretches. We, at Muscatine, Iowa, will lend them our Benson's Horse Power Potato Bug Killer, but we can't spare our lady bugs."

The following enemies of the Colorado Potato-beetle, are among the most prominent which have been instrumental in checking its ravages during the past summer.

THE COLORADO POTATO-BEETLE PARASITE—*Lydella doryphoræ*, N. Sp.
(Diptera Tachinidæ.)

This fly (Fig. 48) has probably been more efficient in checking it than any one other insect, at least in our own State. Until last year no parasitic insect whatever was known to prey internally upon it, but this fly destroyed fully ten per cent. of the second brood and fifty per cent. of the third brood of potato-beetles that were in my garden. It bears a very close resemblance, both in color and size, to the common house fly, but is readily distinguished from the latter by its extremely brilliant silver-white face.

[Fig. 48.]



It may be seen throughout the summer months flying swiftly from place to place, and deftly alighting on fence or wall, where, basking in the sun, its silvery face shows to good advantage. As with the rest of the family to which it belongs, the habit of the female is to attach a single egg externally to the body of the Potato-beetle larva. This egg subsequently hatches into a little footless maggot, which burrows into the body of its living victim, and eventually destroys it, but not until it has gone underground in the usual manner. The victimized larva instead of becoming a pupa, and eventually a beetle, as it would have done had it not been attacked, begins to shrink as soon as it enters the ground, and gradually dies; while inside its shriveled skin the parasitic maggot contracts into a hard brown pupa, and in due time issues forth in the shape of the fly which I have figured. I am indebted to Mr. Wm. LeBaron, of Geneva, Illinois, for the generic determination of this fly. It belongs to the genus (or sub-genus) *Lydella* Macquart, and is very closely allied to *Tachina* proper, with which it could properly be united, did not the great number of species require a division as a matter of necessity. I subjoin a more detailed description of the fly:

LYDELLA DORYPHORÆ, New Species.—Length 0.25. Alar expanse 0.48. Antennæ black. Palpi fulvous. Face silvery white. Front silvery, tinted with pale golden-brown, with a broad middle stripe black. Thorax cinereous with imperfect black stripes. Abdomen black and silvery-

ash, changing into each other when viewed from different angles. When viewed from above: first segment deep black with a posterior border of silver-ash very narrow in the middle, much widened laterally, but abreviated at the sides of the abdomen. The other segments with the basal half silvery-ash, terminal half black. Legs black. Fourth longitudinal vein of the wings straight after the angle. Posterior transverse vein arcuate.

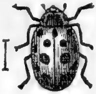
Described from numerous bred specimens.

LADYBIRDS.—In the egg state the Colorado Potato-beetle is preyed upon by no less than four distinct species of Ladybirds. Foremost among them is the Spotted ladybird (*Hippodamia maculata*, DeGeer) which is one of our most common species and is of a pink color, marked with large black spots as in Figure 49. Next comes the Nine-spotted ladybird (*Coccinella 9-notata*, Herbst) which is of a brick-red color and marked with 9 small black spots as in Figure 50. Next, the Thirteen-spotted ladybird (*Hippodamia 13-punctata*, Linn.) which is also of a brick-red color but marked with 13 black spots as in Figure 51. And last but not least, the little species figured at 52, *a*, which may be known as the Convergent ladybird (*Hippodamia convergens*, Guer.) and which is of an orange-red color marked with black and white as in the figure. This last species alone has been of immense benefit in checking the ravages of the Potato-beetle. Its larva is represented of the natural size at Figure 52, *a* its colors being blue, orange and black; when full grown it hangs by the tail to the underside of a stalk or leaf and transforms into the pupa represented at Figure 52, *b*. In this state it is of the exact color of the Colorado beetle larva and is doubtless quite often mistaken for that larva and ruthlessly destroyed. It may readily be distinguished however by its quiescence, and let every potato grower learn well to recognize it and spare its life! The larvæ of all these ladybirds are more bloodthirsty in their habits than the perfect beetles, and the larva of the little Convergent ladybird is so essentially a cannibal that whenever other food fails, it will turn to and devour the helpless pupæ of its own kind. It is a rather cruel and withal a somewhat cowardly act to thus take advantage of a helpless brother; but in consideration of its good services, we must overlook these unpleasant traits in our little hero's character! All these larvæ bear a strong general resemblance, and with the aid of Figure 52 *a* and the annexed Figure 53, a good idea may be obtained of them. They run with considerable speed, and may be found in great numbers upon almost all kinds of herbage. The larvæ of certain species that prey upon the Hop Plant-louse in the East are well known to the hop-pickers as "black niggers" or "serpents," and are carefully preserved by them as some of their most efficient friends.

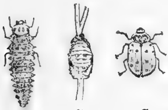
[Fig. 49.]

[Fig. 50.]

[Fig. 51.]

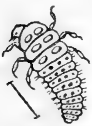


[Fig. 52.]



A B C

[Fig. 53.]

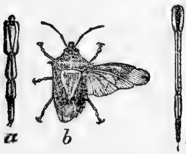


The eggs of ladybirds greatly resemble those of the Colorado Potato-beetle, and are scarcely distinguishable except by

their smaller size and by a much smaller number being usually collected together in a single group. As these eggs are often laid in the same situation as those of the potato-feeding insect, care must be taken by persons who undertake to destroy the latter, not to confound those of their best friends with those of their bitterest enemies.

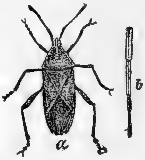
The Spined Soldier-bug.—In the larva state the Colorado Potato-beetle is extensively depredated on, both in Illinois, Missouri and

[Fig. 54.]



Iowa, by the Spined Soldier-bug (*Arma spinosa*, Dallas), which is of an ochre-yellow color and is represented with one pair of wings closed and the other pair extended, in the annexed Figure 54.—Thrusting forwards his long and

[Fig. 55.]



stout beak, he sticks it into his victim, and in a short time pumps out all the juices of its body and throws away the empty skin. He belongs to a rather extensive group (*Scutellera* family) of the true bugs (*Heteroptera*), distinguishable from all others by the very large scutel, which in this genus is triangular, and covers nearly half his back. Most of the genera belonging to this group are plant-feeders, but there is a sub-group (*Spissirostres*) to which our cannibal friend belongs, characterized by the robustness of their beaks, and all of these, seem to be cannibals. To illustrate to the eye the difference between the beaks of the cannibal sub-group and the plant feeding sub-groups of this family, Figure 54 *a* gives a magnified view of the beak of our insect seen from below, and Figure 54 *c* a similarly magnified view of that of a plant-feeder belonging to the same family (*Euschistus punctipes*, Say), which is so nearly of the same size, shape and color as our cannibal friend, that at first sight many persons would mistake one for the other. The Spined Soldier-bug, however, may be at once distinguished from all allied bugs, whether plant feeders or cannibals, by the opaque brown streak at the transparent and glassy tip of its wing-cases.

It has sometimes been reported that the common Squash-bug (*Coreus tristis*, DeGeer) preyed upon the Colorado Potato-beetle; but there can be little doubt but that the Spined Soidier-bug has in these instances been mistaken for it. The colors of the two are somewhat similar but in the eyes of an entomologist the Squash-bug looks as different from the Spined Soldier bug as a cow does from a horse! The figure (55, *a*) of the former which is given above, opposite to that of the latter, will enable any one to recognize the difference, while its magnified beak (Fig. 55, *b*) indicates by its slenderness that it is a plant-feeder.

The Spined Soldier-bug by no means confines himself to Potato-beetle larvæ, but attacks a great number of other insects.

[Fig. 56.]

The Bordered Soldier-bug.—This is another insect which attacks the Colorado Potato-beetle. It belongs to the same sub-group, and has the same kind of short robust beak as the preceding, but unlike that species, it is so conspicuously and prettily marked that it cannot easily be confounded with any other. Its colors are dark olive-green and cream-color, marked as in Figure 56. It is not so common as the preceding species.

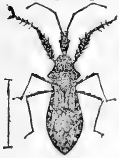
The Many-banded Robber.—Another true bug, still more elegantly marked than the preceding, (*Harpactor cinctus*, Fabr.,) was observed by Dr. Shimer, of Mt. Carroll, Illinois, to attack the Colorado larvæ, and I found it attacking the same larva in our own State the present year. Like the Spined Soldier-bug, this species is common, and inhabits trees more commonly than herbaceous plants. But it belongs to an entirely different group of the true Bugs (*Reduvius* family), all of which, without exception, are cannibals, and are characterized by a short, robust, curved beak (Fig. 57, *b*, profile view, magnified). Figure 57, *a*, gives a magnified view of this bug, the colors being yellow, white and black, and it may be known by the name of the Many-banded Robber.

[Fig. 57.]

a *b*

The Rapacious Soldier-bug.—Still another bug belonging to the very same group as the preceding (*Reduvius raptatorius*, Say), I have found sucking out the juices of the Colorado larva, and specimens were sent to me by S. H. Kriedelbaugh, of Clarinda, Iowa, who found it with the same commendable habit in that State. This bug is represented at Figure 58. It is of a light brown color, and may be known by the name of the Rapacious Soldier-bug.

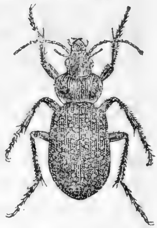
[Fig. 58].



The above four insects are all of them true bugs, and attack the larvæ of the Colorado Potato-beetle with the only offensive weapon that they have—their beak. The four following (Figs. 59 to 62) are all beetles, and are consequently provided with jaws, so that they are able to eat up their victims bodily; and all of them, except the first, which is confined to southerly latitudes, are common throughout the Western States. Most, if not all, of them prey indifferently upon the Colorado larva and the perfect insect produced from it.

[Fig. 59.]

[Fig. 60.]

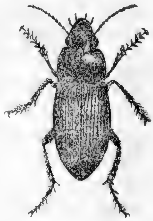


THE VIRGINIAN TIGER-BEETLE.—This beetle (*Tetracha Virginica*, Hope) is of a dark metallic green color, with brown legs, and the annexed cut (Fig. 59) will enable its recognition without much difficulty.

THE FIERY GROUND-BEETLE.—This beetle (*Calosoma calidum*, Fabr.) has already been treated of on page 89 where its larva is illustrated and termed the "Cut-worm lion." The beetle is of a black color, with coppery dots, as shown in Figure 60, and has also been found to prey on the Colorado larva.

[Fig. 61.]

[Fig. 62.]



THE ELONGATE GROUND-BEETLE.—This pretty and conspicuous insect (*Pasimachus elongatus*, *Lec.*) is another enemy of the Colorado Potato-beetle. It is of a polished black color edged with deep blue, and is of a rather elegant form, being represented at Figure 61.

THE MURKY GROUND-BEETLE.—Finally this beetle (*Harpalus caliginosus*, Say) which is of a dull black color, and which is represented life-size at Figure 62, has the same commendable habit as the other three. There are ten or twelve other beetles mostly of small size, which have the same habits as the above; but they would not be readily identified from an uncolored drawing.

BLISTER BEETLES.—Strange as it may seem, the Striped Blister-beetle (Fig. 39, p. 97), and the Ash-gray Blister-beetle (Fig. 40, *a*, p. 98), which have already been described as very injurious to the potato, seem to have the redeeming trait of also preying occasionally on the larva of the Colorado Potato-beetle. It was at first difficult to believe or reconcile the statements to this effect which were reported during the summer, but there have been so many of them that the fact may now be considered as indisputable, and these two Blister beetles may therefore, with propriety, be placed in the list of the enemies of the Colorado beetle. I by no means advise their protection, however, on this account; for I believe that what little good they accomplish is much more than outweighed by the injury they do us. As authorities for these statements may be quoted, among many others, Abel Proctor, of Jo Daviess county, Ill., and T. D. Plumb, of Madison, Wis.

"When dog eats dog, then comes the tug of war;"

when rogues fall out, honest men come by their own. And now that certain potato-beetles have taken to feeding upon other potato-beetles, the American farmer may justly lift up his voice and shout for joy.

Neither ducks, geese, turkeys nor barn-door fowls will touch the larva of the Colorado-beetle when it is offered to them; and there are

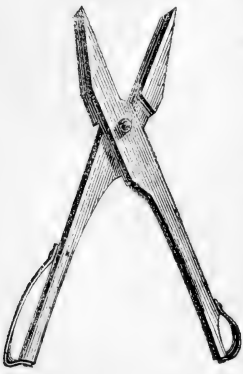
numerous authentic cases on record, where persons who have scalded to death quantities of these larvæ, and inhaled the fumes from their bodies have been taken seriously ill, and even been confined to their beds for many days in consequence.

ARTIFICIAL REMEDIES.—It only remains to say something on the most approved method of fighting the Colorado Potato-beetle. A great deal may be effected by raising your potatoes at a point as remote as possible from any ground where potatoes were raised in the preceding year. A great deal may also be accomplished, where there are no other potato patches in the immediate neighborhood, by killing every beetle found upon the vines in the spring, as fast as they emerge from the ground. By this means the evil is nipped in the bud, and a pretty effectual stop is put to the further propagation of the insect. But if there are potato patches near by, where no attention is paid to destroying the beetles, they will keep perpetually flying in upon you in spite of all you can do.

I have already stated that this insect cannot be driven as can the blister beetles, and we have to rely on other measures. I might occupy page after page in detailing the experiments that have been tried by myself and by others. But of all the mixtures recommended I can seriously recommend none. They are impracticable on a large scale, and require too frequent repetition to be efficient, as the beetles issue from the ground day after day. White hellebore, paris green, slaked lime, etc., etc., I have proved by experiment to be valueless, though the two first will kill, if thoroughly applied, a certain proportion of the larvæ, but will not affect the beetles; and even cresylic acid soap, which is the best wash of the kind, does not kill them all. Hot water affects the pests as fatally as any of these applications, and when I state that I have known the beetles to bore through three inches of hard unleached ashes, the folly of *their* application to the vines becomes at once apparent.

I, therefore, again impress upon my readers the importance of prevention by killing every beetle which first appears in the spring. There is no better way of doing this than by crushing them on the spot, and for this purpose a very simple pair of pincers may be constructed. At Figure 63 I represent a pair that were used last summer by S. H. Ford, of Rolling Prairie, Wisconsin, and which were kindly sent to me by L. L. Fairchild of the same place. Their construction is so simple that it needs no explanation, two pieces of wood, a screw, and two small strips of leather being the only things needed.

[Fig. 63.]



In parts of Iowa, the ravages of this insect were so serious in 1866, that a horse-machine was invented for their destruction

by Mr. Benson, of Muscatine in that State. As this machine, or some improvement on it, may prove advantageous where potato-growing is carried on extensively, I subjoin an account of it.

"The cost of the machine was about thirty dollars. It consists of a frame-work, which moves astride the row of potatoes, on which is mounted longitudinally a reel somewhat like the one on McCormicks' old Reaper, which knocks the bugs off the plants into a box on one side. This box is of course open on the side next the row nearly down to the ground, but is some two feet high on the outside and at the ends. The reel works over the inner edge of the box, and the bugs are whipped off the vines pretty clean; and the most of them are thrown against the higher side of the box, which converges like a hopper over two four-inch longitudinal rollers at the bottom, between which the bugs are passed and crushed. These rollers are some three or four feet long.

"Those insects which are perched low down on the plants are frequently knocked on to the ground; but I think they would soon crawl up again; and repeating the operation at intervals would very greatly reduce their numbers, and lessen very much the labor of hand-picking, which I think would be advisable in conjunction with the use of the machine, in order to destroy the eggs and diminish the young brood, which is most destructive to the foliage of the plant."

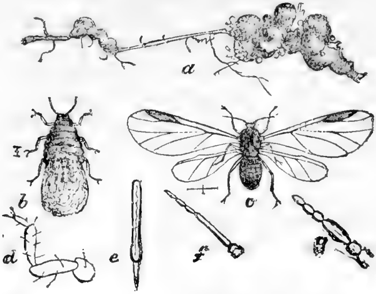
Much may be done by a proper choice of varieties, the Peach-blow having the same immunity from the attacks of this Colorado Potato-beetle, as from those of the Blister-beetles. I have known several instances where Neshannocks, raised side by side with Peach-blows, have been entirely destroyed, while the latter were untouched; and I therefore strongly recommend the planting of Peach-blows in those sections that have been visited by the beetle.

In conclusion let me give another word of caution. Our friends of the Eastern States will, doubtless, in the course of events, become sufficiently acquainted with this beetle. As already stated, it is now in Ohio, and will continue from year to year to spread eastward. Let us, of the West then, not hasten its introduction by our carelessness. Farmers are in the habit of sending insects through the mail to the editors of Eastern papers for identification. Wherever insects are thus sent, they should be thoroughly secured so as to prevent any possible escape. Specimens of this beetle were last year sent to the office of the *American Agriculturist*, in New York, packed in a very insecure manner. Had but a single impregnated female contrived to escape from the package, it might have been the means of prematurely introducing this mischievous pest into that State. A word to the wise is sufficient.

THE APPLE-ROOT PLANT-LOUSE—*Eriosoma* [*pemphigus*] *pyri*, Fitch.

(Homoptera, Aphidæ.)

[Fig. 64.]



The roots of the apple tree are very often found to rot, and thus cause the death of the tree. Of these rots there appear to be three distinct kinds. One kind is that popularly known as "rotten root" in Southern Illinois, and seems to be a simple decomposition of the vegetable tissue, analagous to the rotting of the root of a cabbage for instance. Its cause is not clearly understood, though it seems to be a consequence of certain conditions of the soil. The other rot was discovered the past summer by Dr. Hull, of Alton, Illinois, and is a fungoid growth, which, after covering the root with a thin layer of white fibrous substance, causes a sort of dry rot of the root, and which is common to both the pear and the apple. Some of the symptoms of this rot are: a rather earlier devolopment or maturity of the branches; an excess of fruit buds, and a shortening or thickening of some twigs. Specimens of the affected roots were brought to Dr. T. H. Hilgard, of St. Louis, for experiment, but all that he was able to ascertain was, that it enters the healthy wood in the shape of a brown stringy rot through the canals made by missing fibres.

In a paper read by Dr. Hull, before the Illinois State Horticultural Society, at its 13th annual meeting, a communication was quoted from Judge A. M. Brown, of Villa Ridge, in which the latter gave it as his firm belief that rotten apple tree roots were never caused by root-lice, but by this particular fungus. With due deference to Judge Brown's opinion, I have to differ with him most emphatically, for I am convinced that this Root louse *does cause the roots to rot.* I examined on the 15th of May last, hundreds of young apple trees on the nursery of Mr. J. M. Jordan, of St. Louis. Mr. J. had been greatly troubled with root-lice on his young apple stock during the year 1867, and had dug up and thrown thousands of young trees into a heap, by which means he expected to kill the lice and prevent their spreading onto new stock. He covered this heap with earth a foot deep, and had the gratification of finding that nearly all the lice had died by

the next spring. Many rows of trees—mostly one year grafted—had been left in the ground, however, and on examining these, I found that wherever the previous year the lice had been numerous enough to cover and deform the whole root, there that root had invariably rotted. In many instances all trace of the knots and deformities which the lice cause, had disappeared, while, in some few instances they were yet traceable. In every case where rot had ensued the lice had entirely left, so that not a trace of them could be found. From these, and subsequent observations made during the summer, I conclude that the rot does not ensue till the roots have been completely deformed by the lice, and while on a young tree a colony of lice will multiply sufficiently to entirely cover it in a single season, and thus cause it to rot the next year; on larger trees they may be at work for years before this result is accomplished. This rot from root-lice may, I think, be distinguished from both the other kinds by its being more porous and soft, approximating the brown mould of a rotting log. The unusual swellings and knots caused by the lice, though hard originally, seem to loose their substance, and very frequently the finer roots, and almost always the fibrous roots waste entirely away.

The diagnosis of either of the first two kinds of rot must remain hidden, until our knowledge of these impalpable funguses shall have become more thorough, and until then no remedy can be suggested; but with the last kind, having traced it to its true cause, the means of prevention are at hand, and I will now give the history and description of the Apple-root Plant-louse for the most part as it appeared in the AMERICAN ENTOMOLOGIST for January, 1869:

For the last twenty years a Wooly Plant-louse has been known to infest the roots of the apple-tree, causing thereon swellings and deformations of almost every possible shape, and, when very numerous, killing the tree. In the more northerly parts of the Northern States this insect is comparatively rare, but in southerly latitudes it is exceedingly destructive in apple orchards. According to Dr. Hull, "it is one of the worst enemies against which our apple-trees have to contend, and is much more common in our region than is generally supposed." (*Agr. Rep, Mo., Append.*, p. 451.) As long ago as 1848, Mr. Fulton, of Chester county, Pennsylvania, found this root-louse and the knotty swellings produced by it to be so abundant on nursery-trees in his neighborhood, that thousands of young trees had to be thrown away, and it became difficult to supply the market.) Downing's *Horticulturist*, III, p. 394.) And in August, 1858, M. L. Dunlap (*Rural*) stated in the *Chicago Tribune*, that in an orchard near Alton "the Wooly Aphis infests the roots in immense numbers, and by sucking up the sap destroys the trees, which in its effect has much the appearance of dry rot."

Although this insect usually confines itself to the roots of the tree, yet a few may occasionally be found on the suckers that spring up

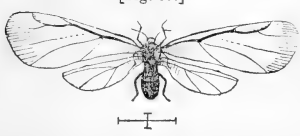
round the butt of the trunk, and even on the trunk and limbs, especially in places where a branch has been formerly amputated, and nature is closing up the old wound by a circle of new bark. Where it works upon the naked trunk, it often causes a mass of little granulations to sprout out, about the size of cabbage-seeds, thus producing on a small scale, the same effects that it does upon the roots. Wherever the insect works, small as it is, it may be easily recognized by the peculiar bluish-white cottony matter which it secretes from its body, and which is never met with in the case of the common Apple-tree Plant-louse that inhabits the leaves and the tips of the twigs.

Figure 64 at the head of this article, fully illustrates the Apple-root Plant-louse. A portion of a knotty root as it appears after the punctures of the lice is represented at *a*, the larva state at *b*, and the winged state at *c*; while *d* represents the leg, *e* the proboscis, *f* the antenna of the winged individual, and *g* that of the larva, all highly magnified. The young louse is of a deep flesh or pink color, and the proboscis extends the whole length of the body, while the older specimens have a deeper, purplish hue. Of the winged louse, I subjoin a more complete description.

ERIOSOMA PYRI, Fitch—Color black. Antennæ 2-5ths as long as the body, joints 1 and 2 almost confluent, short and robust; joint 3 fully ½ the entire length of the antennæ; joints 4—6 subequal, 5 a little the longest, 6 a little the shortest. Meso-thorax polished. Abdomen opaque with more or less pruinescence. Legs opaque black, immaculate. Wings hyaline; costal and subcostal veins robust and black; stigma pale brown, 2¾ to 3 times as long as wide, pointed at both ends, but more acutely so on the basal end, the vein bounding it behind robust and black. Discoidal veins and stigmal vein slender and black, the 3d or forked discoidal hyaline and subobsolete on its basal ⅓. Length to tip of closed wings 0.13—0.14 inch.

On comparing Figure 64 *c* with Figure 65, which represents a Plant-louse that inhabits a large gall on the Cottonwood, it will be observed at once that the veining of the front wing is very different. In Figure 64, *c*, the third branch-vein is very distinctly forked; in Figure 65 it is simple. Nor is this a mere accidental variation, but a peculiarity of the genus to which either insect belongs. (Fig. 64, *c*, genus *Eriosoma*; Fig. 65, genus *Pemphigus*). Now Dr. Fitch describes and names the Apple-root Plant-louse as belonging to the latter genus (*Pemphigus*); whereas winged specimens which both Mr. Walsh and myself obtained last October, at Duquoin, from apple roots and suckers swarming with larvæ; some which I received from St. Louis county, and others which Mr. Walsh bred from larvæ; all, without exception, belong to the former genus (*Eriosoma*). And moreover, Dr. Fitch's insect is described as being nearly twice as large as ours. How does this come about? We can only account for it in the following way: Dr. Fitch's winged specimens were but two in number, and they were found by him, the one living, the other dead, upon the roots of an infested young apple-tree, which had been brought him from an adjoining county. Hence he very naturally, but as we think erroneously, infer-

[Fig. 65.]

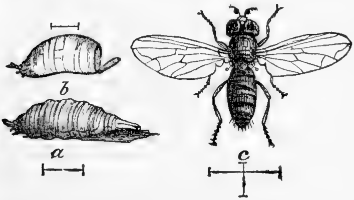


red that these two winged plant-lice belonged to the same species as the minute wingless larvæ with which the infested roots were swarming. The truth of the matter probably was, that the two winged plant-lice got upon the infested apple-root by accident, on their road from the nursery to Dr. Fitch's orchard. Indeed we can almost say with certainty to what species they belonged; for on comparing Dr. Fitch's very minute and elaborate description with the Beech-twig Plant-louse (*Pemphigus imbricator*, Fitch), which comes out in the winged state in the very same time of the year as he met with his two specimens, it agrees sufficiently well to apply to that species. If, on the other hand, we compare his description with our specimens, it not only disagrees generically, as already explained, but neither the size nor the markings will correspond at all.

We consider it, therefore, to be sufficiently certain that the Apple-root Plant-louse does not belong to the genus (*Pemphigus*), to which all subsequent authors, in deference to Dr. Fitch's authority, have hitherto referred it, but to the very distinct genus (*Eriosoma*) to which the notorious Wooly Plant-louse of Europe belongs (*Eriosoma lanigera*, Hausm.)

NATURAL REMEDIES.—From the enormous rate at which all Plant-lice multiply, it is plain that, if there were no check upon the increase of the Apple-root Plant-louse, it would in a few years' time sweep away whole orchards, especially in southern latitudes. Luckily for the fruit-growers and fruit-lovers, there exist two at all events, and probably three such checks. The first is a very minute parasitic fly, which Prof. Haldeman figured and described in 1851 as infesting in the larva state his supposed Wooly Plant-louse.* The second is a footless maggot (Fig. 66 *a*) about one-half an inch long, and of a dirty yellow color. It is generally found more or less covered with mud, and with the woolly matter secreted by the lice, and is not by any means easily discerned. It changes in the fall to the pupa state (Fig. 66, *b*) from which, in the following spring, there emerges the perfect fly (Fig. 66, *c*) which may be known as the Root-louse Syrphus-fly. The following is the description of this fly, in its different stages, which appeared in the AMERICAN ENTOMOLOGIST.

[Fig. 66.]



THE ROOT-LOUSE SYRPHUS-FLY. (*Pipiza radicum*, n. sp.) ♀ Shining brown black. *Head* clothed with short, rather sparse, white hairs, especially the lower part of the anterior orbits and the entire space below the antennæ. Mouth dark rufous. Antennæ compressed, with the joints proportioned as 2, 2, 5; joint 2 twice as wide as 1, and 3 twice as wide as 2; of a dull rufous color, edged above, narrowly on the inside, widely on the outside, with brown black. *Thorax* very finely rugoso-punctate, with some short sparse white hairs, especially laterally. *Abdomen* finely punctate,

* This fly belongs to the *Chalcis* family in the Order *Hymenoptera*, and was named *Eriophilus mali* by Prof. Haldeman. The figure and description will be found in the *Farm Journal* for 1851, pp. 130-1.

with longer white hairs, rufo-piceous above on the middle ⅓ of joint 1; venter with joint 1 piceous. *Legs* with all the 6 knees, and in the 4 front legs the entire tibia except a spot on the exterior middle, and also all the 6 tarsi except their extreme tips, and except in the hind legs the bassal ⅔ of the first tarsal joint, all dull pale rufous. *Wings* hyaline; veins black. Length ♀ 0.25 inch; alar expanse 0.48 inch.

One ♀; ♂ unknown. Bred May 23 from a single puparium found in the November preceding. On May 2 this puparium, which in the preceding autumn had been lightly covered with moist sand and deposited in a cellar, had crawled up out of the sand a distance of two inches, and attached itself to the stopper of the bottle in which it was inclosed. Upon being replaced under the moist sand, it was found two days afterwards to have again crawled about an inch up the side of the bottle. We have observed the same locomotive powers in the puparia of several other Syrphidous insects, though, so far as we are aware, this very anomalous faculty has not hitherto been commented on by authors.

We are indebted to Dr. LeBaron, of Geneva, Ills., who has paid special attention to the Order (*Diptera*) to which this insect belongs, for determining the genus to which it is properly referable. According to him, "the genus *Pipiza* differs from *Syrphus* in the absence of the prominence in the middle of the face, in the comparatively greater development of the posterior legs, and in the want of the little spurious longitudinal vein in the middle of the wing." "The only species discovered by Macquart," he adds, "is from Carolina, and very different from yours."

Larva.—Dull pale flesh-color, tinged with yellow. Attenuated and somewhat depressed anteriorly; more blunt posteriorly, the anal segment being furnished with an elevated tube, which is of a light polished brown at extremity. Wrinkled transversely, with a prominent fold at anterior and posterior edge of each segment. The larger segments well defined; the smaller ones less so. First segment thoroughly retractile, and sufficiently translucent when extended, to show the dark triple-jointed mouth. A few soft, fleshy spines, of the same color as the body, and especially distinct on anal segments. Generally covered and disguised by the soil which it inhabits. Length when not extended, 0.23 of an inch. Described from two specimens taken in 1866 and three in 1868.

Pupa.—Dull dirty yellow. Gradually formed by the contraction of the larva, during which time the wrinkles are obliterated, and it at last becomes quite smooth. Length 0.18.

I first found this larva in December, 1866, at Cobden, Ills., and have found it at several different times since, and though I failed to breed any to the perfect state, Mr. Walsh was more fortunate. Wonderful indeed must be that instinct, which enables the mother-fly to perceive which particular trees in an orchard have their roots swarming with lice, so as to know exactly where to deposit her eggs!

The third insect which preys upon these Root plant-lice, at least in Missouri, is a small species of ladybird, belonging to the genus *Scymnus.* The larva of this beetle is still more difficult to recognize among the lice, as it is covered on the back with little tufts of wooly matter, secreted from its own body. It is, when full grown, somewhat larger than the lice, and altogether more active, and is distinguished furthermore, by the wooly matter being of an even length and distributed over the back in transverse rows. Mr. J. F. Waters, of Springfield, Missouri, sent to me a number of the apple root-lice, with some of these little ladybird larvæ among them, which he erroneously supposed to be the old lice. In due time I bred the perfect beetle from them, and it proved to be a species which the French entomologist Mulsant, had described as *Scymnus cervicalis.* It is a very inconspicuous little beetle, about 0.05 of an inch long, and of a deep brown color, the thorax being of a lighter brown. From subsequent correspondence with Mr. Waters I learned that the lice upon which these little friends of ours were preying, were taken right from the

surface of the ground, so that it is possible that this ladybird only attacks them when it can get at them above ground; though, judging from analogy, I strongly suspect it also seeks them out in their underground quarters.

Artificial Remedies.—The best mode to get rid of the Apple root Plant-louse is to drench the roots of the infested tree with hot water. But to render this process effectual, the water must be applied in quantities large enough to penetrate to every part of the infested roots. There need be no fear of any injurious result from such an application of hot water; for it is a very general rule that vegetable organisms can, for a short time, stand a much higher temperature than animal organisms, without any injury to their tissues. In laying bare the roots for the better application of the water, a sharp eye should be kept for the friends above described, and when espied they should be tenderly laid aside till after the slaughter of the enemy. Mulching around the infested trees has been found, by Mr. E. A. Riehl and others, of Alton, Illinois, to have the effect of bringing the lice to the surface of the ground, where they can be more easily reached by the hot water.

THE WOOLY ELM-TREE LOUSE—*Eriosoma ulmi*, N. Sp.

(Homoptera Aphidæ.)

The White elm is subject to the attacks of a woolly plant-louse belonging to the very same genus as the preceding. This insect appears to be quite common in our State as well as in Illinois, for I have known several elm-trees on Van Buren street in the city of Chicago, to be killed by it, and every tree of this description, around the court house in St. Louis was more or less affected with it last summer. The lice congregate in clusters on the limbs and the trunks, and cause a knotty unnatural growth of the wood, somewhat similar to the knots produced on the roots of the apple-tree by the other species. They are mostly found sunk in between the crevices formed by these knots, and the punctures of their little beaks cause the sap to exude in the shape of little silvery globules, which may generally be found dispersed among the knots. The down or wooly matter is secreted by them from all parts of the body, but especially from the posterior part of the back. It is of an intense white color, and is secreted in such profusion that it usually covers and hides the lice, and when they are numerous, gives the limbs from a distance the appearance of being covered with snow. They make their appearance during the latter part of May, and by the latter part of June the winged individuals may be found mixed up with the larvæ and pupæ. I have experimentally found that a washing with a weak solution of cresylic acid soap will kill them all instantly, and they are thus easily exterminated. They are also preyed upon unmercifully by the larvæ of an undescribed species of Lacewing fly (*Chrysopa eriosoma* of my MS.).

ERIOSOMA ULMI, N. Sp.—Color dark blue. Length to tip of closed wings, exclusive of antennæ, 0.12. Wings hyaline, three times as long as wide, and more pointed at the ends than in *E. pyri*. Costal and subcostal veins, and that bounding the stigma behind, robust and black. Discoidal veins together with the 3d forked and stigmal veins, all slender and black, the forked vein being as distinct to its base as are the others, with the fork but ⅓ as long as the vein itself and curved in an opposite direction to the stigmal vein. Antennæ 6-jointed and of the same color as the body; joints 1, 2, 4, 5 and 6 of about equal length, joint 3 thrice as long as either. Legs of the same color as body.

The young lice are narrower and usually lighter colored than the mature individuals, varying from flesh or pink to various shades of blue and purple.

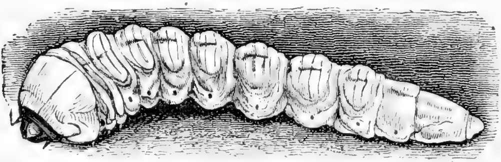
INSECTS INJURIOUS TO THE GRAPE-VINE.

The culture of the grape forms an important branch of Missouri horticulture. There is scarcely another State in the Union that has such natural advantages for the growing of this delicious fruit. While traveling up the Missouri river, I have been struck with the great similarity in the general character of the country to the celebrated Grape-growing districts of the Rhine, in Prussia. The Germans have also so thoroughly settled the country along the Missouri that the resemblance is made still more striking. As another evidence of the importance of this branch of horticulture in our State, the *American Grape Culturist*, the only periodical published in this country that is solely devoted to Grape-growing and wine-making, has just been started in St. Louis, by Mr. George Husmann. It becomes us then to know something of the insects injurious to the vine.

THE NEW GRAPE-ROOT BORER—*Orthosoma cylindricum*, (?) Fabr.

(Coleoptera, Prionidæ.)

[Fig. 67.]



The *ad interim* committees of the Illinois and Missouri State Horticultural Societies, while visiting the orchards and vineyards along the line of the Iron Mountain Railroad, discovered that sundry grape vines on Dr. C. W. Spaulding's place were dying; and on digging up such vines, the roots were found to be entirely hollowed out, and in many instances severed, by a worm which is faithfully represented at the head of this article—Figure 67. At about the same time, Mr. Walsh, of Rock Island, received an immense specimen from W. D. F. Lummis, of Makanda, Illinois, with the same account of its habits, and the following letters which I have since received relate to the same worm:

MR. RILEY—*Dear Sir:* Herewith please find a worm or grub, which has bothered my grape vines, it cuts the vine off about 3 or 4 inches under ground and takes out about an inch. Set vines last spring. Put stakes of oak, green.

Respectfully, &c.,

ALFRED BARTER.

VIRGIL CITY, MO., August 21, 1868.

PROF. RILEY, *State Entomologist:* I leave here for you a specimen of a worm which has proved very destructive in my vineyard this season having killed 24 vines, usually commencing at the bottom eye and eating the entire stem almost to the surface of the ground. I have dug up all the vines and in each case have found but one worm sometimes as deep as 18 inches below the surface. My vineyard was planted this spring on ground previously cultivated; has been thoroughly subsoiled and is well drained; the vines are Hartford Prolifics aud Concords. Please send any information of value you may have relating to the above to Col. John H. Hogan, Pevely Station, I. M. R. R.

Very respectfully,

JOHN H. HOGAN.

September 3, 1868.

MR. RILEY *Dear Sir:* The Grape-vine borer has been quite destructive in our vineyard this season, having killed 15 vines. Except in two cases we found and dispatched him without mercy. We first noticed the effects of the borer about the latter part of July and frequently found them until the latter part of August. In some instances we found the root severed within ½ half an inch of the surface, while the borer was found at the bottom of the root. In others the root was eaten off from 5 to 8 inches below the surface. Only Concord vines have been affected, and only those that we obtained from a neighboring vineyard for planting last spring. Not one of our original vines have been destroyed, though we have 4 acres equally exposed to the attacks of this new destroyer. Any information that you may be able to give us upon this subject will be thankfully received.

Very respectfully,

SIMMONS & TILLSON.

SULPHUR SPRINGS, September 10, 1868.

Mr. D. C. Peebles, D. D. S., of St. Louis, also brought me a large Concord vine that had been entirely severed from the roots and killed by this worm, and I also received specimens about ¼ grown from T. W. Guy, of Glenwood.

The above letters convey a very good idea of the manner in which this borer works. It seems to have occurred in the Concord vines more generally than in those of any other variety, but I think that this may be attributed to the fact that more Concords are planted than any other kind, for as the following facts will show the borer is evidently a very general feeder. In the early part of June, 1867, Mr

O. B. Galusha, who was then with the *ad interim* committee visiting Southern Illinois, sent me a worm in all respects similar which was found boring into the root of an apple tree. I have also received Osage orange roots from Kansas which were being bored by the same fellow, and he is evidently partial to rotten oak stumps for not only have several persons who are well able to judge, assured me that they have found him in such stumps, but Mr. A. Bolter, of Chicago, also found it in such stumps in Kentucky, and sent me the specimens for identification. At the meeting of our State Society, at Columbia, Mr. I. N. Stuart even avowed that he had found it partly grown, not only in seedling apples but in the roots of corn stalks, while Chas. Connon, of Webster, assures me that he has found it in the heart of felled hickory, and I ascertained that he was perfectly capable of distinguishing it from the common borer (*Cerasphorus cinctus*, Drury), which infests hickory when felled, and which causes what is known as "powder post," he being quite familiar with this last named insect. There are several large beetles in the West which must have larvæ very similar in appearance to this, and it is not at all unlikely that different insects have here been confounded, but the figure at the head of this article, with the following description of this Grape-Root borer, will enable any one to recognize it in the future.

LARVA OF ORTHOSOMA CYLINDRICUM, (?) Fabr.—Average length when full grown, 3 inches. Color pale yellowish white, partly translucent, with glaucous and bluish shadings, and a distinct dorsal line of the last color. Segment 1 rather horny, rather longer than 2, 3 and 4 together, broadening posteriorly, slightly shargreened and whiter than the rest of the body, with a rust-colored mark anteriorly. Segments 2 and 3 shortest and broadest, the body tapering thence gradually to extremity, though there is usually a lateral ridge on segment 12 which dilates it rather more than the segments immediately preceding it. This segment 12 is also the longest, the terminal one being quite small and divided into three nearly equal lobes. A swelled hump crossed with two

[Fig. 68.]

impressed transverse lines, on segments 4, 5, 6, 7, 8, 9 and 10. Stigmata rust-colored, 9 in number, the first and largest being placed on a fold in the suture between segments 1 and 2. Head brown, verging to black on anterior edge. Mandibles large, strong, black, with one blunt rounded tooth, giving them a somewhat triangular appearance; antennæ 3-jointed and brown, especially at tip; labrum fulvous, fuzzy and with a brown base; maxillary palpi 4-jointed, the basal joint much swollen, the terminal joint brown, and a ring of the same color at sutures of the other joints; labial palpi 3-jointed, the basal joint also swollen, and the terminal joint and sutures of the others brown. Six rudimentary 2-jointed fuscous feet as shown at Figure 68. Venter tubercled as on the back, these tubercles being especially prominent on segments 6, 7, 8 and 9, where they recall prolegs. The young larva differs only in lacking the rust-colored mark on segment 1.

Now, to what insect does this borer belong? It is manifestly the larva of some long-horned beetle of the family PRIONIDÆ, but of what particular species cannot be positively stated till the beetle is reared from grape-root-boring larvæ. Before another year shall have passed away, I hope to definitely determine this point, but meanwhile, I have every confidence that it will produce the Cylindrical Orthosoma (*Or-*

[Fig. 69.]

thosoma cylindricum, Fabr.), a large flattened, long-horned light bay-colored beetle which is common throughout the country and especially in the Mississippi valley, and which is represented of the natural size at Figure 69. True, according to Westwood, the larvæ of the PRIONIDÆ have the second segment enlarged and broadened, while the closely allied family CERAMBYCIDÆ, has the first segment thus enlarged as in our insect; but from a larva resembling ours in every respect so far as his description goes, and which he found in September, 1867, in decaying pine wood, Mr. Walsh actually bred, about the last of June, 1868, the Cylindrical Orthosoma. The only accounts on record which pretend to give the natural history of this beetle, are by Dr. Fitch and S. S. Rathvon, that of the former in his 4th Report, § 239, and that of the latter in the Agricultural Reportfor 1861, pp. 611–612. Dr. Fitch describes the larva, which he supposed belonged to this beetle, but which he did not breed, as occurring in pine trees, and as having the first ring longest and the second broadest; while Mr. Rathvon figures it with the first ring infinitely shorter than the second, but confesses that the drawing was made from memory, and he doubtless trusted to the authority of Westwood. Furthermore Monsieur E. Perris has figured at Plate 6, Figure 362, of the "Annales de la Société Entomologique de France," for 1856, the larva of *Prionus obscurus*, Oliv. which bores into the pine and which very closely resembles our larva, the first and not the second segment being enlarged.

Until the past summer nothing had been published about the attacks of this insect on Grape roots, and yet upon inquiry I find that it has been known for several years. Mr. Spaulding informs me that the first that was seen of it in his neighborhood was in 1866, when his man found an enormous one in a wild vine which he was about to graft; but Mr. Geo. Husmann, of Hermann, has been acquainted with it since 1850, and has known it to occur around Hermann since 1854. Indeed Mr. Husmann informs me that he has never observed the old Grape-vine Borer which has 16 legs and which produces a moth (*Ægeria polistiformis*, Harris) but that in speaking of the Grape-root Borer he has always referred to this species. Mr. J. H. Tice found it in apple roots in 1860 on the place of James Sappington of St. Louis, while the following item by A. J. H., of Vineland, N. J., which appeared in the January (1869) number of the *Gardener's Monthly*, would indicate that it has the same habit all over the country:

"On page 354 October number of *Agriculturist*, reference is made to a "vine borer" in Missouri that cuts off vines below the surface. It is also mentioned and partially described in the last *Gardener's*

Monthly. This "borer" is an old friend (?) of mine. It is found principally in old rotten oak stumps; I hardly ever dig one out without finding several of these worms. They are about two inches long, tapering from head to tail, white bodies and black heads. I lose on an average about 50 vines and dwarf pears annually by these little villains; probably twice as many pears as vines. I have had several apple trees cut off by them, and one standard pear. The tree roots seem often to be eaten entirely up, but the vine roots are only cut through as if they had obstructed the line of travel.

This is no new insect, but will I think probably be found troublesome whenever dwarf pears and vines are planted among decayed oak stumps."

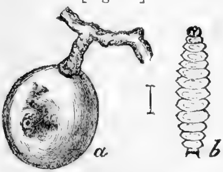
REMEDIES.—Little can be done in the way of extirpating these underground borers, when, as in the present instance, their presence is only indicated by the approaching death of the vine. Still, every vineyardist should make it a rule to search for them wherever they find vines suddenly dying from any cause unknown to them, and upon finding such a borer should at once put an end to his existence. The beetle which may frequently be found during the summer months, should also be ruthlessly sacrificed wherever met with. I should also advise not to plant a vineyard on land covered with old oak stumps, and not to use oak stakes where those made of cedar can be had as conveniently.

THE GRAPE CURCULIO—*Cœliodes inæqualis*, Say.

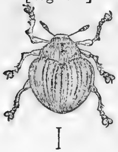
(Celeoptera, Curculionidæ.)

The larva of this Curculio infests the grapes during the months of June and July, causing a little black hole in the skin, and usually a disfigurement and discoloration of the berry, immediately around it as in Figure 70, *a*. The larva (Fig. 70, *b*) is whitish as long as the berry is green, but generally partakes of the color of the berry as it matures. It is footless and like the larvæ of all snout-beetles is incapable of spinning a web. In 1867 I found this insect quite common in Southern Illinois, and as will be seen from the excellent account of it given by Mr. Walsh in his first report, it was very common in the States of Illinois, Ohio and Kentucky, and it also occurred in our own State, as I am informed by Mr. Peabody. From the middle to the last of July, this larva leaves the berry and buries itself a few inches in the ground. Here it changes to a pupa within a small, smooth earthen cavity, and by the beginning of September the above named beetle issues from the ground, and doubtless passes the winter in the beetle state, ready to puncture the grapes again the following May or June. This beetle is

[Fig. 70.]



[Fig. 71.]



small and inconspicuous, being of a black color with a grayish tint. It is represented enlarged at Figure 71, the hair line underneath showing the natural size. It is distinguished from all other curculios that are known to attack our fruits by having a rectangular thorn or tooth on the upper and outer edge of the four front shanks (*tibiæ*) as shown at Figure 72; this character being peculiar to the genus (*Cœliodes*) to which it belongs.

[Fig. 72.]

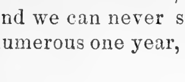
Strange as it may seem, in 1868 there seems to have been an almost entire immunity from this Grape curculio, for I have neither met with it in a single instance, nor heard of its occurrence. No doubt this immunity has been caused principally by parasites, for I failed entirely to breed the perfect Curculio in 1867, on account of some small Ichneumon which killed the larva as soon as the latter had entered the earth, and spun for itself a tough silken cocoon in the place where the Curculio larva, if unmolested, would have undergone its transformations. It is thus that Nature works; "eat and be eaten, kill and be killed," is one of her universal laws, and we can never say with surety that because a particular insect is numerous one year, therefore it will be so the next!

THE GRAPE-SEED CURCULIO.

(Coleoptera, Curculionidæ.)

A minute maggot was discovered last August infesting the seeds of the Grape in certain parts of Canada, by Mr. Wm. Saunders, of London. It causes the berries to shrivel up and utterly ruins them. Specimens which had been received from Canada, were sent to me by my friend A. S. Fuller, of New Jersey, and the annexed Figure 73

[Fig. 73.]



shows a highly magnified view of the maggot, its natural size being represented underneath. The head is of the same translucent, milk-white color as the body, but the jaws, which are finely pointed, are light brown, and there is a patch of brown at their base. It has exactly thirteen segments exclusive of the head, and every segment has a few white, fleshy hairs, these hairs being thickest near the head and longest on the under part of the first three segments, thus imitating feet, as is often the case with footless larvæ of this character.

It is evidently the larva of some curculio, and though it is not yet known to occur in the States, I append the following account of it from Mr. Saunders himself, for the benefit of our Grape-growers:*

* This account is taken from a paper published by Mr. Saunders in the "Report of the Commissioner of Agriculture and Arts of the Province of Ontario," for 1868—pp. 203–5.

"On the 20th of August last we observed that many of the berries in the bunches of a Clinton vine under our care were shriveling up. On opening the grapes, we observed that most of the smaller berries —that is those which had shriveled earliest—contained only one seed, and that of an unusually large size. Some of the larger shriveled grapes contained two seeds, much swollen, each having a dark spot somewhere on their surface. On cutting the seeds carefully open, the kernel was found almost entirely consumed, and the cavity occupied by a small milk-white footless grub with a pair of brown hooked mandibles, a smooth and glossy skin with a few very fine short white hairs. When at rest it is nearly oval in form, but when in motion its body is elongated, varying in length from one-fifteenth to one-twelfth of an inch. * * *

"The Clinton vine on which this pest was first discovered suffered considerably, fully ten per cent. of the crop was lost from the shriveling of affected berries. At first we supposed that the work of the insect was confined to berries of this appearance, and that by destroying these the destruction of the crop of insects for the season would be complete, but further examination showed that many of the ripe berries contained affected seeds. The proportion thus affected on the vine referred to was about ten or eleven per cent. Within a few feet of this vine an Isabella was fruiting; on this there were no shriveled berries, but about three per cent. of those which had ripened were injured. About the same distance in another direction was a Hartford Prolific, and about ten feet further off a Concord, both of which fruited well. On neither af these were there any shriveled berries, nor could we find any affected seeds among those which had ripened. The fruit of a Delaware, about fifty feet distant from the Clinton, was also examined without discovering any traces of the insect.

"About the middle of September we visited the grounds of Mr. Charles Arnold, of Paris, and there we found that this insect had prevailed to a greater extent than it had with ourselves, affecting the Clinton, Delaware, one of Rogers' Hybrids, and also Mr. Arnold's new seedlings. In Hamilton, in the garden of Mr. W. H. Mills, we found an affected seed in a berry of Rogers' No. 4. On the 24th of September we visited the vineyard of the Vine Growers' Association at Cooksville, but could not find any traces of the insect there. Thus far its depredations are most apparent about London and Paris, but probably further examination will show that it is widely distributed.

"Where any shriveled berries are found their seeds should be carefully opened and examined, as it is important to know how far the insect prevails. The affected berries are usually swollen, somewhat soft, and have a dark spot somewhere on their surface; any of this character observed among the ripe berries should also be examined.

"In the case of the shriveled berries, where one seed only is af-

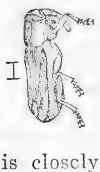
fected, the others are dwarfed and imperfect; and where two large seeds are found they are both occupied. Where one seed only is affected and the other remains healthy, the one normal seed carries the berry through in an apparently healthy state to ripeness. As far as our experience goes the Clinton and its allies with thin skins are more liable to attack than berries with thicker skins, such as Hartford Prolific and Concord.

THE GRAPE-CANE GALL-CURCULIO, *Madarus vitis*, New Species

(Coleoptera, Curculionidæ.)

The canes of the Concord vine are frequently found to have galls on the last year's growth, in the shape of an elongated knot or swelling which is generally situated immediately above or below a joint. This gall was formed the previous fall while the tender cane was growing, and has almost invariably a longitudinal slit or depression on one side, dividing that side into two cheeks, which generally have a rosy tint. The gall is caused by a little footless, white cylindrical larva which measures 0.28 of an inch, and has a yellowish head, and somewhat darker tawny jaws. It is minutely wrinkled transversely, and sparsely covered with minute white bristles; the three segments next to the head being prominently swollen underneath and the bristles attached to them look very much like legs, and doubtless to some extent perform the functions of legs. This larva indeed bears a very close general resemblance to that of the Potato Stalk-weevil, illustrated at page 93, Figure 37 *a*, and when taken out of its gall immediately curls up as in that figure. During the latter part of June this larva transforms within the cane to a pupa, also greatly resembling that figured at *b*, on page 93, with the exception that it is much smaller, and that the wings and legs reach down three-fourths the length of the body instead of but one-half as in that species. Two weeks after it has thus transformed it becomes a beetle belonging to the great Curculio family. Before this insect had ever been bred to the perfect state I predicted that it would produce a Curculio, as may be seen by referring to page 117 of the Transactions of the Illinois State Horticultural Society for 1867. This beetle is represented enlarged at Figure 74, its natural length being 0.10. It is of a uniform light yellowish-brown without any markings whatever. It is closely allied to the Potato Stalk-weevil, but belongs to the genus *Madarus* which differs from *Baridius* in the peculiar undulating appearance of the wing-cases, and more especially in their being highly polished, the word *Madarus* meaning glossy or polished. This little

[Fig. 74.]



Curculio was considered a new species by Dr. Le Conte, in 1861, and as it has not, so far as I am aware, been described since that time, I subjoin a more complete description of it:

Madarus vitis, N. Sp.—Length, exclusive of rostrum 0.10. Color uniformly rufous, without maculations, the eyes alone being darker. Highly polished; rostrum arcuated, stout and about as long as thorax; thorax and body with extremely minute and distant punctures, anterior margin of thorax abruptly narrowed, especially laterally, into a collar; elytra slightly undulate, with 4 distinct elevations, one on the extreme outer margin close to the thorax, and one on the middle of each, near the extremity.

As an illustration of the great similarity in the habits of insects belonging to the same genus, I will state that there is a small black Curculio, belonging to the genus *Madarus* and differing from this Grape-cane Gall-curculio in no other respect but in color, whose larva lives in a somewhat similar gall found on the common creeper (*Ampelopsis quinquefolia*) which is very closely related to the vine. This black species is also undescribed and is marked *Madarus ampelopsis* in Mr. Walsh's collection.

I think it highly probable that the gall of the Grape-cane Curculio is caused more by the punctures which the female beetle makes in depositing her egg, than by the irritations of the larva; for I have found the larva where it had burrowed two and three inches up the cane, away from the gall, without its having caused a corresponding swelling; though this has always been in the one-year-old cane.

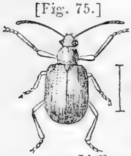
Remedy.—If these gall-bearing canes are cut off and burned during the winter there need be little fear of this insect's work, the more especially as it is not secure from parasites, even in its snug retreat, for I have bred a species of *Chalcis* fly from the galls, which had evidently destroyed the true gall-maker.

THE GRAPE-VINE FIDIA—*Fidia viticida*, Walsh.

(Coleoptera, Chrysomelidæ.)

One of the worst foes to the grape-vine that we have in Missouri is the Grape-vine Fidia which is represented in the annexed Figure 75. It is of a chestnut-brown color, and is densly covered with short and dense whitish hairs which give it a hoary appearance. I have found it very thick in most of the vineyards which I visited, and it is almost universally miscalled the "Rose-bug," which is, however, a very different insect. The Grape-vine Fidia was first described by Mr. Walsh in the May, 1867, number of the *Practical Entomologist*. It is found in the woods on the wild grape-vine and also on the leaves of the *Cercis Canadensis;* but of the tame vines it seems to prefer the Norton's Virginia and Concord. It makes its appearance during the month of June, and by the end of July has generally disappeared, from which fact we may infer that there is but one brood each year. The

[Fig. 75.]



manner in which it injures the vine is by cutting straight elongated holes of about $\frac{1}{8}$ inch in diameter in the leaves, and when numerous it so riddles the leaves as to reduce them to mere shreds. The preparatory stages of this beetle are not yet known.

REMEDIES.—Luckily this beetle has the same precautionary habit of dropping to the ground, upon the slightest disturbance, as has the Plum curculio, and this habit enables us readily to keep it in check. The most efficient way of doing this is by the aid of chickens. Mr. Peschell, of Hermann, on whose vines this beetle had been exceedingly numerous, raised a large brood of chickens in 1867, and had them so well trained that all he had to do was to start them in the vineyard with a boy in front to shake the vines, and he himself behind the chicks. They picked up every beetle which fell to the ground, and in this manner he kept his vines so clean that he could scarcely find a single beetle in 1868.

THE GRAPE CODLING, *Penthina vitivorana*, Packard.—Plate 2, Figs. 29 and 30.

(Lepidoptera, Tortricidæ.)

Although the preceding insect has been so scarce in 1868, yet the Grape has been worked upon in a somewhat similar manner, and even to a greater extent, by the insect now under consideration. Indeed there is very little doubt that Mr. Walsh, not being acquainted with this insect, confounded its work with that of the Grape-curculio, in some of the instances, of the damage done by this last, which are quoted by him in his report, and this is especially the case in the instance of Mr. M. C. Read of Hudson, Ohio.

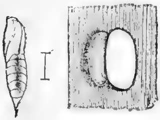
I first received this insect, with an account of its workings, from Huron Burt, of Williamsburg, and subsequently during the month of July, found it universal in the vineyards along the lines of the Pacific and Iron Mountain Railroads. It was found equally common around Alton in Illinois, while Dr. Hull informs me that it ruined 50 per cent. of the grapes around Cleveland, Ohio, the Concord and Ives Seedling being the only varieties which appeared to resist its attacks. It also occurs in Pennsylvania, judging from articles which appeared in the November and December numbers of the *Practical Farmer*. In these numbers my esteemed correspondent, Mr. S. S. Rathvon, of Lancaster, Pennsylvania, gives an account, with description, of some worms which were sent to him by the editors, answering in every respect to this Grape codling. Concluding, from its similarity to the common Apple-worm, that the insect belonged to the genus *Carpocapsa*, he proposed for it the name of *Carpocapsa vitisella*, without having bred the parent moth. In the June number of the *American*

Naturalist (p. 220) is quoted an account of it by Mr. M. C. Read, of Hudson, Ohio, who says that it is "already so abundant there that it is necessary to examine every bunch of ripe grapes, and clip out the infested berries before sending them to the table."

The larva of this Grape-codling may at once be distinguished from that of the Grape curculio, by its having 6 scaly legs near the head, 8 fleshy legs in the middle, and 2 at the extremity of the body, and by spinning a fine web, by which it lets itself drop whenever handled. It is also larger, of a darker color, and bears a very close resemblance to that of the Strawberry leaf-roller, to be hereafter figured and described.

Its presence is soon indicated by a reddish-brown color on that side of the yet green grape which it enters. On opening the grape, a winding channel is seen in the pulp, and a minute white worm with a dark head is seen at the end of the channel. It continues to feed upon the pulp of the fruit, and when it reaches the seeds, eats out their interior. As it matures it becomes darker, being either of an olive-green or dark brown color, with a honey-yellow head, and if one grape is not sufficient it fastens the already ruined grape to an adjoining one by means of silken threads, and proceeds to burrow in it as it did in the first. When full grown it leaves the grape and forms its co-

[Fig. 76.]



a b

coon on the leaves of the vine. This operation is performed in a manner essentially characteristic: the worm cuts out a clean oval flap, leaving it hinged on one side, and, rolling this flap over, fastens it to the leaf, and thus forms for itself a cozy little house which it lines on the inside with silk. One of these cocoons is represented at Figure 76, *b*, and though the cut is sometimes less regular than shown in the figure, and I have had them spin up in a silk handkerchief without making any cut at all, it is undoubtedly the normal habit of the insect to make just such a cocoon as represented. In this cocoon, within two days, it changes to a chrysalis, such as is represented at Figure 76, *a*, of a honey-yellow color with a green shade on the abdomen; and in about ten days more the moth makes its escape, the chrysalis having first pushed itself almost entirely out of the cocoon. The moth is of a slaty-brown color with corky-yellow markings, and is represented enlarged at Plate 2, Figure 29, and of the natural size at Figure 30.

Specimens of this moth were sent by Mr. Walsh to the English Lepidopterist, H. T. Stainton, who could not refer it to any known genus; but Dr. Packard, of Salem, Massachusetts, refers it to *Penthina* a genus very closely allied to *Carpocapsa*, to which our Apple Codling moth belongs. He has also kindly furnished me with advanced sheets of Part V of the "Guide to the Study of Insects," in which (p. 336) he describes and figures it under the name of *Penthina vitivorana*. The description is quite brief, however, and the figure not good,

and I therefore subjoin a more detailed description of it in its different stages:

PENTHINA* VITIVORANA, Packard—*Larva.*—Average length 0.35. Largest on segments 10 and 11, tapering thence gradually to the head and suddenly to anus. Color either dark shiny olive-green, glaucous, or brownish. Head and cervical shield honey-yellow, the latter with a darker posterior margin. Piliferous spots scarcely distinguishable. Described from 10 specimens.

Crysalis—0.18—0.20 long. Of normal form. Quite variable in color. Usually of a light honey-yellow, with a green shade on the abdomen, and black eyes, but sometimes entirely dark-green, with light eyes. The chrysalis skin, after the moth has left, is always deep honey-yellow, with the green abdominal mark distinct.

Perfect insect—Average length 0.17; alar expanse 0.37. Head, thorax, palpi and basal half of antennæ fulvous Terminal half of antennæ darker. Legs fulvous, becoming darker on tarsi. Ground-color of fore wings pale slate-blue, with a slight metallic lustre, which becomes lighter and somewhat silvery interiorly and posteriorly. A dark rich-brown band, with a light, somewhat silvery annulation proceeds from the middle of the costa towards the inner margin, becoming paler interiorly; its basal margin being indistinct, but running almost straight across the wing, its outer margin well defined, curving to a rounded point which reaches to the middle of the outer third of the wing and thence running obliquely inwards, nearly to the middle of the inner margin. Beyond this middle band is a large, deep brown, somewhat oval spot, also lighter below than above, and with a pale annulation, which is broken on the outer side above, allowing the spot to extend to the margin of the wing. Above this large spot, at the apex, is a small perfectly round dark spot, with a bright annulation inclining to orange color. The space enclosed by the middle band, and these two spots just described, is brown above, with usually four lighter fulvous costal marks quite distinct, each mark divided at costa by a slight touch of brown. Another somewhat triangular brown spot, with a light annulation above, runs from the posterior angle up between the middle band and large oval spot. The blue space from the middle band to the base of wing is generally brownish near the base, with a brown line across the middle from costa to inner margin, and with two other costal brown marks. The fringes partake of the ground-color. Hind wings slate-brown, darkest near the margins; fringes same color. Body brownish with frequently a clear green tint. The male differs principally in its somewhat smaller size, and especially in the smaller size of the abdomen. Individuals vary greatly.

Described from 5 ♀ and 2 ♂ specimens, all well preserved and fresh.

REMEDIES.—This insect threatens to become a grievous pest unless checked by some unforseen means, as was the case with the Grape curculio. Luckily, there is at least one parasite which attacks it, in the shape of a yellowish, footless maggot, with a green tint and 14 segments. I obtained such maggots from two of the caterpillars, one having crawled out of its host before, and the other after he had spun up. Absence from home prevented my breeding this parasite, but it would doubtless have produced some 4-winged fly belonging to the *Chalcis* family (see Pl. 2, Figs. 6 and 9). According to Mr. Read, the first brood of caterpillars feed on the leaves, appearing in May (in Ohio) or as soon as the leaves are grown. The worms which appear in our grapes in July are, therefore, the second brood, and there is doubtless a third brood, for Mr. Rathvon received them in October, and I have taken the worm out of a grape as late as the 22d of September. The broods, in all probability, run into one another and the last passes the winter within the cocoon, either in the larva or pupa state. They should, therefore, be searched for early in the season on the leaves. The second brood of worms, or those which infest grapes, can easily be espied and destroyed in a healthy vineyard; but where a vineyard

*Heinemann and Lederer unite the genus *Penthina* wrth *Grapholitha*, under the latter name, and I believe Mr. C. T. Robinson, of New York, follows them in this respect.

is affected with what Prof. Turner, of Jacksonville, Illinois, designates as the "American Grape rot," the grape attacked by the Codling are not so easily distinguished, as they bear a close resemblance to the rotting ones. Care should be taken in gathering the infested grapes for the worm being very active wriggles away and easily escapes.

THE EIGHT-SPOTTED FORESTER, *Alypia octomaculata*, Fabr. Pl. 1, Figs. 18 and 19.

(Lepidoptera, Zygænidæ.)

At Plate 1, Figure 19, is represented a caterpillar which has been sent to me by several correspondents with the statement that it was found on their grape vines, and during the month of May, I found the same caterpillar on the vines of Mr. T. R. Skinner, of Cheltenham, and of Mr. Peabody, of Sulphur Springs. It grows to the length of 1¼ inches, and is transversely striped with bluish-white and black, about 4 white and 4 black lines on each segment, with two small black spots in the middle light band on the back. The head and a shield on the first segment are shiny gamboge-yellow, with black dots, and on the 11th segment there is an orange elevation, not shiny and with two black spots in it. From similar caterpillars, which were taken from grape vines in 1865 I bred in the spring of 1866 the moth figured at Plate 1, Figure 18, known as the Eight Spotted Forester (*Alypia octomaculata*, Fabr.) It is recognized at once by its conspicuous markings, being of a black color with orange shanks, each of the fore wings with two large light yellow spots and each of the hind wings with two white spots. The caterpillars leave the vines during the month of June, and descend into the earth where they form for themselves slight cocoons of earth in which they remain through the winter and from which the moth escapes the following April.

It is not probable that this caterpillar which may be called the Blue Caterpillar of the vine, will ever become exceedingly numerous, for it has not been known to become so in the past, and this hasty sketch of its history is given principally for the gratification of the intelligent grape-grower who takes pleasure in thoroughly understanding and knowing, in all their different guises, the creatures he has to deal with.

There are two other caterpillars very much resembling this, which also feed on the vine; but they produce very different looking moths, the one known as *Eudryas grata*, Fabr., and the other as *Eudryas unio*, Hübner. Dr. Fitch in his 3d Report §123 states that the larva of *E. grata* differs only from that of *A. octomaculata* in lacking a white spot on each side of every segment, and in being slightly humped at its hind end. The specimen from which my figure was

made may prove to be *E. grata*, for it had no such white spots and *was* humped; but it differs essentially from the most excellent description of this last larva which A. S. Packard, Jr., has given in his "notes on the family Zygænidæ, pp. 27–29, and sufficiently resembles those from which I actually bred the 8-spotted Forester.

THE GRAPE-VINE PLUME, *Pterophorus periscelidactylus*, Fitch. Plate 2, Figs. 15 and 16.

(Lepidoptera, Alucitidæ.)

During the latter part of May and beginning of June, the leaves of the grape-vine may often be seen drawn together by silken threads and in the retreat thus made will be found a small hairy caterpillar which feeds on the tender leaves of the vine. This caterpillar grows to the length of about half an inch; the color of the body is very pale green and has four elevated white spots and two still smaller dots on every segment, from which spring stiff white hairs in all directions.

This caterpillar was quite common last summer in many sections of the State. It was first named by Dr. Fitch, who found it on the vine in the State of New York. A number which I brought home changed to chrysalids during the first days of June, and the moths were produced from them in about 8 days afterwards. The worm first spins a few threads of silk to the underside of a leaf, or other object, and the chrysalis attaches the lower part of the terminal segments to them, and hangs with the tail somewhat curved, at a slant of 40° from the object, as represented at Plate 2, Figure 16. This chrysalis measures 0.35—0.40 in length, is of a light-green color and of peculiar form. It is ridged, with remnants of the tubercles of the caterpillar. It is angular and cut off slantingly and bluntly at the head, but is characterised principally by two sharp and angulated projections from the middle of the back, and which are enlarged under the figure 16, in Plate 2.*

The moth (Pl. 2, Fig. 15) is of a tawny yellow color, the wings marked with white and with a darker shade. The caterpillars disappear very suddenly, for the chrysalis is so small and so nearly the color of the leaf, that it would be seldom noticed, even it were not so well hidden. There are probably two broods in the year, though I failed to find any trace of them after the first had disappeared.

All the moths of the family (ALUCITIDÆ) to which this belongs have very appopriately received the name of Plumes. In the genus *Pterophorus* the fore wings are divided into two and the hind

*Dr. Fitch has given a most excellent and full description of this chrysalis in his 1st Report pp. 140–141.

wings into three lobes, and to show how very different insects may be in the larva state, both in habit and appearance, even when they belong to the same genus and greatly resemble each other in the perfect state, I have represented at Plate 2, Figure 13, another Plume, which I shall presently describe as the Thistle Plume.

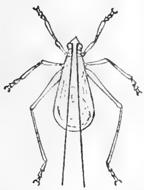
Remedies.—Whenever they become numerous, as they did last summer, the only remedy is hand-picking.

THE TREE-CRICKET—*Œcanthus niveus*, Harris.

(Orthoptera, Achetidæ.)

This insect is represented in the annexed cuts, Figure 77 showing the male, and Figure 78 the female. The general color is a delicate greenish, semi-transparent white, though some specimens have a blackish shade. From the fact that it is known to devour plant-lice and likewise the eggs of some moths, I was formerly in doubts whether it should be considered friend or foe, but the experience of the past year settles the matter definitely, for it has proved very destructive to the vine. The female deposits her eggs in grape canes, raspberry and blackberry canes, in the twigs of the peach, White willow, and a variety of other trees. In depositing, she makes a straight, longitudinal, contiguous row of punctures, each puncture about the size of that which would be made by an ordinary pin. From each of these holes, a narrow, yellowish, elongate egg, runs slantingly across the pith. The twigs or canes thus punctured almost invariably die above the punctured part, and the injury thus caused to vines is sometimes considerable.

[Fig. 77.]



[Fig. 78.]

But by far the worst habit of the Tree-cricket is that of severing grapes from the bunches just as they are beginning to ripen, and it sometimes cuts off an entire bunch, or so thoroughly excoriates the stem that it fails to ripen its berries. I have seen the ground under some vines covered with grapes which had been thus severed, but should never have accused the Tree-cricket, had I not found it in the very act, and received specimens with accounts of this same habit, both from Mr. B. L. Kingsbury, of Alton, Illinois, and from J. H. Tice, of St. Louis. This cricket is aided in this destructive work by another species which has the same habit, namely the Jumping Tree-cricket (*Orocharis saltator*, Uhler.) This last insect is more robustly built than the former, and is at once distinguished by its uniform light-

brown color, and I have good reason to believe that it deposits its eggs in the grape-vine in a row of punctures, each of which is about one-third of an inch apart, and each of which leads to from ten to twelve narrow eggs, about a tenth of an inch long, and deposited on either side of the puncture, length-wise in the pith.

REMEDY.—The crickets themselves should be crushed whenever met with, while the vineyardist should make a business of searching in the winter time for all punctured twigs, and by burning them, prevent their increase in future.

THE RASPBERRY GEOMETER, *Aplodes rubivora*, N. Sp.—Pl. 2, Figure 25.

(Lepidoptera Geometridæ.)

The lovers of those most exquisite fruits, the Raspberry and the Blackberry are often greatly disgusted by the discovery of the fact that instead of the delicious berry which they expected to enjoy, they are munching the small caterpillar now under consideration. This caterpillar was quite numerous last summer on both the above named fruits at South Pass, Illinois. It has the peculiar faculty of thoroughly disguising itself with pieces of dried berry, seed, pollen, and other *debris* of the fruit, which it sticks to a series of prickles with which it is furnished. Add to this disguise the habit which it has of looping itself into a small ball, and it almost defies detection. It is most numerous during the months of June and July. Through the kindness of Mr. T. A. E. Holcomb, of South Pass, I was enabled to breed this insect to the perfect state. From two specimens of the larvæ which he sent me, I bred from one, July 9th, the little moth which is illustrated at Plate 2, Figure 25, the other being infested with a parasite which formed a tough cocoon, very much like that of a parasitic fly (*Campoplex fugitivus*, Say), which I have bred from milkweed feeding larvæ of *Euchætus egle*, Harris. This little moth is of a delicate light grass-green color, with two paler lines running across both wings as in the figure. It belongs to the genus *Aplodes*, and as I am informed by Dr. Packard, comes very near to *glaucaria* Guénée, and has not hitherto been described. In the proceedings of the Boston Society of Natural History (Vol. IX, pp. 300-2) Mr. Walsh has described an oak-feeding Geometer which closely resembles this, both in the larva and perfect states. He erected the new genus *Hipparchiscus*, for it and gave it the specific name *venustus*. It is a much larger insect, and differs in sundry respects from the species under consideration, though the moth is of the same color and somewhat similarly marked.

APLODES RUBIVORA, N. Sp.—*Larva*—Average length 0.80. Color light yellowish-gray, darker just behind each joint, and very minutely shagreened all over. On each segment a prominent pointed straight projection each side of dorsum, and several minor warts and prickles below. Two very slightly raised, longitudinal lighter lines along dorsum, between the prominent prickles. Ten legs.

Perfect insect—Alar expanse 0.50; length of body 0.25. Color verdigris-green, the scales being sparse so that the wings appear sub-hyaline. Fore-wings with two transverse lighter lines dividing the wing into three parts, proportionate in width as 3, 4, 2 counting from base, and parallel with posterior margin; also a faint line between these two, running to about ⅓ of wing from costa. Hind wings with two similar transverse lines, dividing the wing in like proportion, the outer line not parallel with margin, but wavy and produced posteriorly near its middle. Costa pale; fringes obsolete. Head, thorax and abdomen green above, but, together with antennæ and palpi, white beneath.

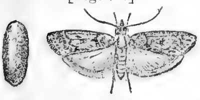
Described from one ♀ specimen.

THE GOOSEBERRY FRUIT-WORM, *Pempelia grossulariæ*, Packard.—Pl. 2, Fig. 17.

(Lepidoptera, Phycidæ).

On June 8th, I received from Mr. Geo. H. Cherry of Hematite, a number of diseased gooseberries, with an account of their prematurely turning red and rotting. The cause was a smooth thick glass-green worm which is more fully described below. Subsequently on the 12th of the same month, I received the same species of worm with a similar account of its work, from Mr. Stephen Blanchard, of Oregon; on the 16th from Jos. F. Bryant, of Bethany, with the statement that it was "feeding on and hollowing out" his currants, and on the 17th from Dr. W. A. Monroe of Bloomington with the statement that it was destroying his native gooseberries and Green gage plums. Mr. A. Fendler and F. R. Allen, both of Allenton, likewise informed me that it entirely ruined their currant crop, and I afterwards found the same insect on the currants and gooseberries wherever I went, and it doubtless occurs over the whole country, for as we shall presently see, it attacks the gooseberry both in the State of New York, Massachusetts, and in Canada.

[Fig. 79.]



Dr. Fitch, in his 3d Report, §149, makes brief mention of it though he was not acquainted with the parent moth. He concludes his account in the following words: "I have sometimes seen bushes of the wild gooseberry with every berry withered and reduced to a mere dry hollow shell, with a cob-web like tube protuding from the orifice in one side. And the present summer a letter to the *County Gentleman*, from E. Graves Jr. of Ashfield, Mass., states that for three years past, his 'Houghton's seedling' gooseberries have been a total failure from this same worm, as I am assured by the account which he gives of it and the specimens accompanying his letter."

As soon as gooseberries and currants are well formed, this worm begins to make its presence known by causing the berries which it infests to prematurely turn red or dull whitish. After eating the inside of one berry, leaving a hole for the passage of the excrement, it enters another berry, making a passage way of silk, until it draws together a bunch of currants, or two or three gooseberries as the case may be. The berries thus attacked sometimes drop, but more gener-

ally the hollow shell mixed with cob-web-like silk shrivels up and hangs on to the bushes. During the latter part of June the worms descend from the shrub and spin for themselves brown cocoons (Fig. 79, *a*) in the leaves and rubbish on the ground. Here they change to brown chrysalids and remain in this state through the winter and come forth in the spring as moths. Thus there is but one brood of this insect each year, and yet by the middle of July there is never a worm to be found, and the chrysalis consequently remains quiescent alike through the hottest summer and the coldest winter weather. As the worms which I procured are still in the chrysalis state, I should have been unable to present the complete history of this pest, in this my first report, had it not been for the kindness of Mr. William Saunders of London, Canada, whom I met in Chicago, at the meeting of the "American Association for the Advancement of Science," and who very fortunately had with him specimens of the moth which he had bred from gooseberry-feeding worms, found in Canada, the description of which answered exactly to those of mine. But to make doubly sure that the insect which Mr. Saunders bred, is the same species as ours, I purposely forced one of my chrysalids. On the 25th of January, 1869, the markings of the wings showed through the chysalis skin, which was loose and brittle. These signs indicated that the forthcoming moth was in an advanced state of development, and on carefully taking away the chrysalis skin, it lay before me with nothing lacking to bring it to perfection but the inflating of the wings. Their markings were however perfect and distinct and agreed entirely with the Canadian specimen.

This moth is represented at Figure 79, *b* and still more faithfully at Plate 2, Figure 17, its general color being pale gray. It belongs to the genus *Pempelia*, and from advance sheets of Dr. Packard's "Guide" I learn that he has named it *P. grossulariæ*, and it may be known in English as the Gooseberry Pempelia.

REMEDIES.—Care should be taken to gather and destroy the worms while they are yet in the fruit, as they are afterwards found in the chrysalis state with great difficulty. If chickens are allowed to run amongst the bushes after the fruit has gone, they will materially assist in checking it by devouring such chrysalids as are within their reach.

PEMPELIA GROSSULARIÆ, Packard—*Larva*—Average length 0.65; thickest in the middle of body, tapering thence slightly each way. Color glass-green, partly translucent, shiny, and with a roseate hue on the upper surface. Head of a light gamboge-yellow, with tawny lips. Cervical shield not very prominent and of the same color. No other markings whatever. A few very fine white hairs, especially near the head and tail. 16 legs, the thoracic ones the same color as head, the others green.

Described from 10 specimens.

Chrysalis—Length 0.38. Of the normal form, and dull mahogany-brown color. The spiracles appearing like small tubercles and the extremity furnished with several stiff rufous curled bristles.

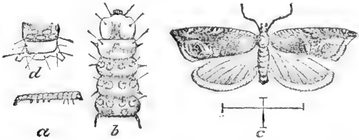
Perfect insect.—Length, including palpi, 0.40; alar expanse, 0.80. Color pale-gray. Front wings with a dark transverse diffuse band on the inner third, enclosing a zig-zag white line not reaching the costa. A dark discal spot, constricted in the middle, the upper and lower edges con-

tinued basally in the shape of two faint lines to the transverse band already mentioned, where they almost converge, the space enclosed by them being whiter than the rest of the wing, with a darker line along the middle. Beyond this discal spot, at about the outer fourth of the wing is another dark but less distinct diffuse transverse band, nearly parallel with posterior margin and with a white zig-zag line produced into an acute angle, basally, on the internal margin, the space between this band and the discal spot being also quite light. A row of marginal black dots, with the apex light. Fringes concolorous. Hind wings somewhat more dusky with darker margins and veins and lighter fringes. Head, thorax, abdomen, antennæ, palpi and legs all pale gray, being more silvery on the under than on the upper side.

One specimen from Wm. Saunders.

THE STRAWBERRY LEAF-ROLLER, *Anchylopera fragariæ*, Walsh and Riley—Pl. 2, Figs. 26 and 27.

[Fig. 80.]



The above figure represents an insect which devours the leaves of our strawberries. A more perfect picture of the moth is given enlarged at Plate 2, Figure 26, and of the natural size at Figure 27. It was first described in the January number of the *American Entomologist*, from which I take the following account of it.

For nearly two years, we have been acquainted with a little greenish leaf-roller, measuring about one-third of an inch, (Fig. 80, *a*), which in certain parts of North Illinois and Indiana, has been ruining the strawberry fields in a most wholesale manner; and which also occurs in Canada, judging from an account in the *Canada Farmer* of August 1, 1867. It crumples and folds the leaves, feeding on their pulpy substance, and causing them to appear dry and seared, and most usually lines the inside of the fold with silk. There are two broods of this leaf-roller during the year, and the worms of the first brood, which appear during the month of June, change to the pupa state within the rolled-up leaf, and become minute reddish-brown moths (Fig. 80 *c*) during the fore part of July. After pairing in the usual manner, the females deposit their eggs on the plants, from which eggs in due time, hatches a second brood of worms. These last come to their growth towards the end of September, and changing to pupæ, pass the winter in that state.

We first heard of this leaf-roller in the summer of 1866, when it did considerable damage at Valparaiso, Indiana, and we were informed by Mr. N. R. Strong, of that place, that in 1867 they continued their depredations with him, and destroyed 10 acres so completely as not to leave plants enough to set half an acre, and that in consequence

of this little pest in conjunction with the White-grub, he has had to abandon strawberry culture.

When we met the *ad interim* committee of the Illinois State Horticultural Society at Lacon, in the beginning of July, 1868, we received from these gentlemen a quantity of infested strawberry leaves, from which in the course of the next two or three weeks we bred many of the moths. These specimens had heen collected at Mr. Bubaugh's place, near Princeton, Illinois, where they were said to be very abundant, and to have completely destroyed one strawberry patch containing several acres.

Subsequently we received another lot of specimens from Mr. W. E. Lukens, of Sterling, Whiteside, county, Illinois, with the following remarks upon this very important subject:

"Where these insects are thick I would never think of raising strawberries. It is strange that I have not noticed any of their work upon this side the river; while on the south side for a mile up and down they are ruining the crops of berries. Removing the plants does not take with them the moth nor the eggs, so far as has been observed. A gentleman by the name of Kimball, at Prophetstown, had his crop a few years ago entirely destroyed by this insect, though it amounted in all to two or three acres. I hear of a great many men in other places having their crops burnt up with the sun, and have no doubt that it was this leaf-roller, and not the sun, that was the real author of the damage. As for myself, I have on this account entirely quit the business of growing strawberries."

The only modes of fighting this new and very destructive foe of the strawberry—which, however, seems to be confined to northerly regions—are, first, to plough up either in the spring or in the fall, such patches as are badly infested by it, by which means the pupæ will probably be buried and destroyed; and second, not to procure any plants from an infested region, so as to run the risk of introducing the plague upon your own farm.

We annex brief descriptions of this insect, both in the perfect and larval states. We are indebted to the distinguished English Microlepidopterist, H. T. Stainton, for the generic determination of the species, and for the further remark that "it is closely allied to the European *Anchylopera comptana* (Manual Vol. II, p. 225), which feeds on various Rosaceæ, such as *Poterium sanguisorba, Potentilla verna,* and *Dryas octopetala.*"

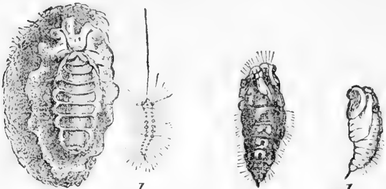
Anchylopera fragariæ, New species—Head and thorax reddish-brown. Palpi and legs paler. Antennæ dusky. Tarsal joints tipped with dusky. Front wings reddish-brown, streaked and spotted with black and white as in the figure. Hind wings and abdomen dusky. Alar expanse 0.40–0.45 inch. Described from nine specimens.

The Larva measures, when full grown, 0.35 of an inch. Largest on the first segment tapering thence very slightly to the last. Color varying from very light yellowish-brown to dark olive-green or brown. Body soft, somewhat translucent, without polish; the piliferous spots quite large, shining, always light in color, contrasting strongly in the dark specimens with the ground color. Hairs, especially lateral ones, quite stout and stiff. Spots arranged in the normal form, segments 2 and 3 having none, however, on their posterior half as have the rest (See Fig. 80, *b*) Head horizontal, of a shining fulvous color, with a more or less distinct dark eye-spot and tawny upper lip. Cervical shield of the same shiny appearance. Anal segment with two black spots (See Fig. 80, *d*) at posterior edge, being confluent and forming an entire black edge in some specimens. Legs, prolegs, and venter of the same color as the body above.

THE WHITE-MARKED TUSSOCK MOTH—*Orgyia leucostigma*, Sm. & Abbott.

(Lepidoptera, Arctiidæ.)

[Fig. 81.]


a *b* *c* *d*

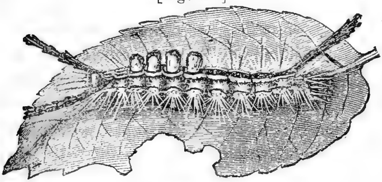
During the winter little bunches of dead leaves are sometimes found to be quite numerous on our apple trees. They are generally fastened to the twigs, and upon examination are found to contain gray cocoons. The greater portion of these cocoons have an egg-mass glued to them, which is composed of numerous perfectly round, cream-colored eggs, of about 0.03 diameter, and partly covered with glistening white froth-like matter; while the other proportion of these cocoons have no such egg-mass.

About the middle of the month of May these eggs begin to hatch, and continue thus to hatch in different parts of the orchard for over a month. The young caterpillar which hatches from these eggs is represented at Figure 81, *b*. It at first measures 0.10 in length, and is of a dull, whitish-gray color with the underside paler or of a dirty white, and with the tufts on the back of a dark brown. In two days after hatching, orange spots commence to appear along the back, and especially on segments 2, 3, 8 and 9. On the seventh day after having remained stationary for about two days, fastened to some part of the tree with silk, it casts its skin for the first time, after which operation the hairs are more numerous, the dark portions more intensely black, the orange parts of a brighter orange and the two tufts near the head longer. As it approaches the time of the second moult, the underside becomes more glaucous, a yellow line begins to appear at the sides, and in some cases the orange marks become yellow, with the exception of a small, perfectly round spot on segments 9 and 10 which always remains orange; the neck or first segment, where it joins the head, also becomes orange or yellow. Six days from the time of the first moult the second moult takes place, the worm having become lighter colored each day. Immediately after the shedding of the second skin it measures 0.30; the collar is more intensely orange as well as the head, while four cream-colored tufts appear on the back of segments 4, 5, 6 and 7, and the two round spots on segments 9 and 10 are of a very bright scarlet-orange. As it grows and approaches the third moult, the orange collar becomes more conspicuous, the back becomes of a perfect velvety black; the cream-colored tufts become

smaller, whiter, and the fourth frequently obsolete; a transverse row of four yellow warts becomes conspicuous on segments 2 and 3; a subdorsal yellowish line appears, starting from segment 8 and running and diminishing posteriorly; the upper sides become of a dark bluish-gray, while the yellow line along the lower sides becomes more distinct. Six days after the second moult the third moult takes place with but little change in the appearance of the caterpillar, further than that the different colors become still more bright and distinct and the different tufts still larger.

Up to this time all the individuals of a brood have been alike, and of a size, so that it was impossible to distinguish the sexes. Six days from the third moult, however, the males measure not quite $\frac{3}{4}$ of an inch, and begin to spin their cocoons; while the females undergo a fourth moult about this time, and in about six days more they also spin up, having acquired twice the size of the male when he spun up.

[Fig. 82.]



The annexed Figure 82 represents the full grown female caterpillar, it differing from the full grown male only in its larger size. At this stage of its existence the caterpillar is a most beautiful object, with its vermillion-red head and collar, its cream-colored brushes and its long black plumes.

When young these caterpillars make free use of a fine web which they spin, and by which they let themselves down when disturbed, and it is quite amusing to watch them ascend again whenever they have become sufficiently assured that there is no danger. They perform this feat with the thoracic legs, using those of each side alternately, the body and head being thrown from side to side in harmony, very much as a sailor climbs a rope " hand over hand."

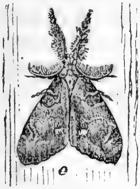
It may puzzle some persons to divine how such a hairy and tufted caterpillar can possibly cast off its skin and yet retain these pretty appendages. After having remained stationary without food for about two days, the old skin becomes dry and somewhat loose. If at this time this old skin be carefully removed. it will be found that an entirely new set of these appendages has been forming underneath it; the two long plumes curled over the head, down by the feet and up again to near the scaly collar; the four white brushes folded close together inwardly crossing each other; the anal plume folded below the anus, and all the other hairs laid in thread-like bunches close to the body in a posterior direction. In due time the old skin splits on the back, near the head, and the caterpillar gradually works it off posteriorly. The moment they are exposed the appendages which had been compressed, as described, to the body, commence to straighten

out, and in a few minutes the new dress is displayed in all its beauty and freshness. The long plumes at the head do not straighten out of their own accord, however, for the caterpillar by a curious curling of the body, while resting on a few of its abdominal prolegs, cunningly brushes them with its tail end, first on one side, then on the other. It furthermore presses them, for the same end, one after the other against any surface on which it is at the time walking, and having once thoroughly straightened out its toilet it rests a few minutes from its efforts and then commences to feed with surprising vigor, apparently determined to make up for its two day's fast.

The male cocoon is white or yellowish, and sufficiently thin to show the insect within it. It is formed of two layers, the outer one having the tufts and plumes which adorned the maker, scattered through it. The female cocoon is twice as large and more solid and dense.

Soon after completing his cocoon the male changes to a chrysalis, which is represented of the natural size at Figure 81, *d*. The female, in due time, changes to a very different chrysalis, which is also represented life-size at Figure 81, *c*. In about two weeks after spinning up, the moths begin to issue. In this state the sexes are still more dissimilar. The male produces a winged moth, which is represented at Figure 83, while the female is furnished with but the merest rudiments of wings, and is destined to simply crawl to the outside of her cocoon, where, after the male has met her, she deposits her eggs, gluing and protecting them with the white frothy matter already described, which, at this time, has every appearance of spittle. She is faithfully represented at Figure 81, *a*, and after depositing her eggs, the body greatly contracts and she soon dies.

Fig. 83.



Such is an outline of the natural history of this pretty, but destructive caterpillar. In our State there are two broods each year, the moths of the first brood appearing during the latter part of May and fore part of June, and those of the second brood in September and October. The periods given for the transformations are average periods, and in further illustration of the difficulty in drawing rigid lines of time, in the development of insects, I will state that from a hundred larvæ which hatch out in a single day, some will have produced moths while others are yet feeding in the caterpillar state.

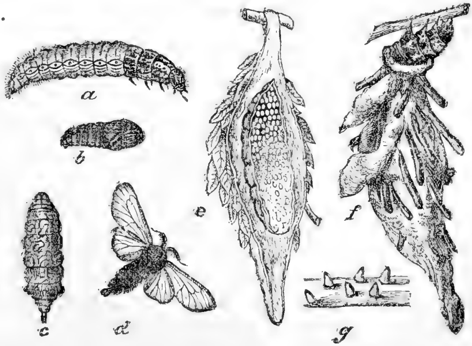
This insect seems to occur more or less over the whole country, and I have repeatedly received its egg-masses during the past two winters. It is, however, as we might expect from its nature, often confined like the Canker-worm, to particular orchards in a particular neighborhood. It feeds upon different kinds of trees, such as the elm, maple, horse-chestnut and oak, but it seems to prefer the apple, the plum, the rose and the pear.

REMEDIES.—Dr. Fitch has described two parasites, which attack this caterpillar, and I am acquainted with seven others, making in all nine distinct parasites, which prey upon this species. It was my intention to have described and figured some of these parasites, but the time in which this Report must be ready for the Public Printer forbids my doing so, the present year, and it suffices to say that in collecting the cocoons in the winter in order to destroy them, *none but those which have the egg-masses on them should be taken, as all the others, either contain the empty male chrysalis or else some friendly parasite!* From the fact that the female never travels beyond her cocoon, it becomes obvious that, since the insect can only travel in the caterpillar state, it would require over a century for it to spread even a hundred miles. Hence we may rightly conclude that it has been introduced to different parts of the country in the egg-state on young imported trees. How essential it is then to examine every tree in planting out a young orchard, and how easy it is with the proper precautions to forever keep an orchard free from its destructive work. As already stated, the young worms let themselves down upon slightly jarring the tree, and though after the third moult they lose this habit to a great extent, yet they may always be brought down by a good thorough shake, and where they have once invaded an orchard, this will be found the most feasible mode of killing them; though *prevention* by destroying the egg-masses in the winter when they are easily discerned, is infinitely the best and surest remedy against its attacks.

THE BAG-WORM, *alias* BASKET-WORM, *alias* DROP-WORM—*Thyridopteryx ephemeræformis*, Haworth.

(Lepidoptera, Psychidæ.

[Fig. 84]



Our shade and ornamental trees are often defoliated by various insects, and I will give brief accounts of three which have attracted

my attention during the past summer. Of these, the insect whose transformations are illustrated above, is by far the most common and injurious. It apparently flourishes better south of latitude 39° than north of that line. It occurs on Long Island, and in different localities in Pennsylvania, Ohio, Maryland, District of Columbia, the Carolinas, Georgia, Alabama, Kentucky, South Illinois and in the southern half of our own State, and doubtless in some of the other States, though I have no records to judge by. In St. Louis county it is very plentiful. Year after year shade trees are planted along the streets and avenues of this city, and year after year a great proportion of them dwindle and die, until at last the opinion very generally prevails among land-owners that it is of little use to try and grow them. Consequently they are not as generally planted as they should be, and St. Louis, with all her natural advantages, lacks to a great extent, those beautiful vistas and long rows of trees which so characterize and adorn some of our more Eastern cities.

Why is it that so many of these trees dwindle? No one seems to know! Can it be owing to the character of the soil, or of the climate? Most emphatically, no!—in these respects there is no more favored city on the continent, and for the proof we need only to visit Mr. Shaw's beautiful gardens, or Lafayette Park, or any of the nurseries around the city. What then, is the cause? Why, the very Bag-worm which forms the subject of this article. It swarms all over the city proper, but decreases in numbers, as a general rule, as one approaches or gets beyond the limits, and is comparatively rare in the above mentioned places. The reason for this is obvious when we understand its history, for it can spread but gradually, and has naturally multiplied most in those places where it has longest existed—namely, in the older parts of the town.

The natural history of the insect is interesting, and may be thus briefly given:

Thoughout the winter the weather-beaten bags may be seen hanging from almost every kind of tree. Upon plucking them many will be found empty, but the greater proportion of them will, on being cut open, present the appearance given at Figure 84, *e*; they are in fact full of soft yellow eggs. Those which do not contain eggs are the male bags and his empty chrysalis skin is generally found protruding from the lower end. About the middle of next May these eggs will hatch into active little worms, which, from the first moment of their lives, commence to form for themselves little bags. They crawl on to a tender leaf, and, attached to their anterior feet with their tails hoisted in the air, they each spin around themselves a ring of silk, to which they soon fasten bits of leaf. They continue adding to the lower edge of the ring, pushing it up as it increases in width, till it reaches the tail and forms a sort of cone, as represented at Figure 84, *g*. As the worms grow, they continue to increase their bags from the bottom, until the latter become so large and heavy that the worms let

them hang instead of holding them upright, as they did while they were young. By the end of July they have become full grown, when they present the appearance of Figure 84, *f*. The worm on being pulled out, appearing as at Figure 84, *a*. This full grown condition is not attained, however, without critical periods. At four different times during their growth these worms close up the mouths of their bags and retire for two days to cast their skins or moult, as is the nature of their kind, and they push their old skins through a passage which is always left open at the extremity of the bag, and which also allows the passage of the excrement.

During their growth they are very slow travelers and seldom leave the tree on which they were born, but when full grown they become quite restless, and it is at this time that they do all their traveling, dropping on to persons by their silken threads and crossing the sidewalks in all directions. A wise instinct urges them to do this, for did they remain on one tree, they would soon multiply beyond the power of that tree to sustain them, and would in consequence become extinct. When they have lost their migratory desires, they fasten their bags very securely by a strong band of silk to the twigs of the tree on which they happen to be. A strange instinct leads them to thus fasten their cocoons to the *twigs* only of the trees they inhabit, so that these cocoons will remain secure through the winter, and not to the leaf-stalk where they would be blown down with the leaf.* After thus fastening their bags, they line them with a good thickness of the same material, and resting awhile from their labors, at last cast their skins and become chrysalids. Hitherto the worms had all been alike, but now the sexes are distinguishable, the male chrysalis (Fig. 84, *b*) being but half the size of the female chryalis (shown inside of the bag at *c*). Three weeks afterwards a still greater change takes place, the sexes differentiating still more. The male chysalis works himself down to the end of his bag and, hanging half-way out, the skin bursts and the moth (Fig. 84, *d*) with a black body and glassy wings escapes. and when his wings are dry, soars through the air to seek his mate.—She never leaves her case, but issues from her chrysalis in the shape of an abortive, footless and wingless affair (Fig. 84, *e*) and after copulating, works herself back into the chrysalis skin, fills its upper but posterior end with eggs and stops up the other end with what little there is left of her body when she gets through. These eggs which are quite soft and yellowish, pass the winter protected in the bags, and produce young worms again the following spring, which go through the same cycle of transformations thus hurriedly described.

This insect is essentially polyphagous, for it occurs alike on ever-

*I have noticed that the Ailanthus tree is almost entirely exempt from the attacks of this worm, but cannot yet tell whether this is because the leaves are repulsive to it, or whether, the leaves being compound, the worm's instinct fails it, in that it fastens its case to the mid-stalk, which falls and carries the case with it to the ground. I incline to the latter belief however, from the fact that the insect is such a general feeder, and that a few isolated cases are sometimes seen attached even to Ailanthus twigs, showing that they can feed and mature on this tree.

green and deciduous trees. I have found it on the elms, the common and the honey locusts, Lombardy poplar, catalpa, Norway spruce, arbor-vitæ, Osage orange, soft and silver maples, sycamore, apple, plum, cherry, quince, pear, linden, and above all on the red cedar, while Mr. Glover has also found it on the cotton plant in Georgia. It is also exceedingly hardy and ruddy, and the young worms will make their bags of almost any substance upon which they happen to rest when newly hatched. Thus they will construct them of leather, paper, straw, etc., etc., and it is quite amusing to watch their operations.

NATURAL REMEDIES.—The only parasite which has been hitherto known to attack this Bag-worm is one known as *Cryptus inquisitor*, Say, which Mr. Glover figures on Plate 11, Figure 5, of his yet unpublished plates of four-winged flies. Last September, through the kindness of Miss M. E. Murtfeldt of St. Louis, I discovered another parasite which lives in the body of the worm to the number of five or six at a time, and which after destroying their victim, spin for themselves tough white silken cocoons within the bag, as represented at Plate 2, Figure 10. The Ichneumon fly which issues from these cocoons has never been described, and as the sexes differ remarkably, I subjoin a full description of each. The female is represented at Plate 2, Figure 11, and the male at Figure 12, and it will be seen at once that while the wings of the former are clouded, those of the latter are perfectly clear. This fly belongs evidently to the genus *Hemiteles* though it differs from most species in having the areolet wanting.

HEMITELES (?) THYRIDOPTERYX, N. Sp.—♀ Length, 0.36; expanse 0.50. Ferruginous, opaque. Head transverse, rather broader than thorax, the front much depressed; face prominent centrally beneath antennæ, closely punctured, thinly clothed with pale pubescence; clypeus and cheeks shining; tips of mandibles black; antennæ, long, slender, filiform, ferruginous, blackish at tips; thorax rugose; scutellum prominent, with sharp lateral margins; metathorax prominent, quadrate, abrupt laterally and posteriorly, finely reticulated and pubescent, the upper posterior angles produced on each side into a long, divergent, flattened, subacute spine; disk with two longitudinal carinæ, from which diverges a central transverse carina; tegulæ piceous; wings hyaline, subiridescent; a narrow, dark fuliginous band crosses the anterior pair a little before the middle, and a broad band of same color between middle and apex, this band having a median transverse hyaline streak; areolet wanting, second recurrent nervure straight, slightly oblique; apex of posterior wing fuscous; legs long and slender, ferruginuous, more or less varied with fuscous; posterior coxae, tips of their femora, and their tibiæ and tarsi, fuscous; base of four posterior tibiæ more or less whitish, forming a rather broad annulus on posterior pair; abdomen petiolated, subconvex, densely and finely sculptured, blackish, basal segment tinged with reddish, the second and third segments distinctly margined at tip with whitish; apical segments smooth and shining, thinly pubescent; ovipositor half as long as abdomen, sheaths blackish.

♂.—Not at all like the ♀. Length 0.33, expanse 0.44. Long, slender, black, polished without distinct punctures, thinly clothed with white pubescence; palpi white; antennæ long, slender; scape reddish; mesothorax gibbous, with two deeply impressed longitudinal lines; metathorax with well-defined elevated lines, forming several irregular areas; sides rugulose, apex without spines or tubercles; tegulæ white; wings whitish-hyaline, subiridescent, the nervures and stigma white, subhyaline, neuration as in ♀; legs long, slender, pale honey-yellow; coxæ, posterior trochanters, apex of their femora, and their tibiæ and tarsi, blackish; base of posterior tibiæ with a white annulus; abdomen long, slender, flattened, petiolated, smooth and polished, the apical margin of second segment being narrowly whitish.

Described from four ♀ and one ♂ specimens bred from the same cocoon.

Artificial Remedies.—From the natural history of this Bag-worm it becomes obvious, that by plucking the cases in the winter time, and burning them, you can effectually rid your trees of them, and I advise all who desire healthy trees to do this before the buds begin to burst in the spring. Where this is not done the worms will continue to increase, and partly defoliating the tree each year, slowly, but surely, sap its life.

In conversation some time since with Mr. Edward Cook, who is superintending the improvements in Washington Park, St. Louis, I showed him that every one of the young trees that had been lately planted there had from six to a dozen of these Bag-worms hanging from their twigs. I explained to him that the trees would never thrive with these parasites, and that, prevention being easier than cure, he had better have them plucked off at once, while they were within reach. He informed me afterwards that he had gathered two barrels full from these trees, but there are many yet left, which should be removed before spring.

THE AILANTHUS WORM—Larva of *Œta compta*, Clem., Plate 2, Figs. 22 and 23.

(Lepidoptera, Tineidæ.)

The Ailanthus is highly prized in most of our cities as a shade tree, and though there certainly are other trees as quick growing, and as hardy, which might advantageously take its place, yet as it has an almost perfect immunity from the attacks of the Bag-worm and continues to be grown, it will be of interest to know what insect enemies it has. Fortunately it has very few, but every St. Louisan must have noticed last fall that nearly all the young Ailanthus trees around the city, and in the parks, looked black and seared as though they had been scorched by fire. Few probably divined the cause of this phenomenon, but it was the work of the worm which is the subject of this chapter.

This worm is slender and of a very dark olive-brown color, with white longitudinal lines. During the months of August and September it may be found of all sizes, living in communities of from five to thirty individuals within a slight silken web. Did they but feed on the leaves their injury to the tree would be slight, but they have the miserable habit of gnawing the leaf stalk in two, and of severing the leaf, and causing it to turn black; thus marring the looks of large trees and killing many seedlings outright. When the worm is full grown it suspends itself in the middle of the loose web and changes to a chrysalis about $\frac{1}{2}$ inch long and of a dull smoky-brown color. The chrysalis skin is so very fine, that as the future moth develops

within, the colors of its wings show distinctly through it. The chrysalis state lasts on an average about two weeks, at the end of which time the moth bursts forth. In this state it is one of the neatest and most beautiful little moths that can well be imagined. At Plate 2, Figure 22, it is represented of the natural size, expanded, and at Figure 23 with the wings closed. The fore wings are of a bright metallic golden-orange, crossed transversely with bands of very pale chrome-yellow, marbled with black; while the underwings are smoky black, and almost transparent in the middle. The first moths begin to appear during the first days of September, and continue issuing from the crysalids till the last of October. From the fact that I could get none of them to deposit eggs, I infer that they pass the winter in the moth state—the more readily since I have had them escape from the crysalis even in November. They are very fond of flitting over and clinging to the flowers of the Golden rod and of the *Eupatorium serotinum*.

This insect probably occurs throughout the Southern States, for Mr. Glover has found it in Georgia. It is doubtless confined to the Ailanthus tree, though when pushed for food I found that the worms were not at all fastidious about devouring their brethren that were in the helpless chrysalis state. It was named *Pœciloptera compta* by the late Dr. Breckenridge Clemens, but as the genus *Pœciloptera* was pre-occupied in insects, Mr. A. Grote, of New York, proposed the generic term *Œta*, and we thus have a scientific name for our little moth—*Œta compta*—which the most prejudiced against the so-called "Crack-jaw-Latin" can hardly find objection to.

The easiest way of getting rid of the worms is to cut off the branch containing the nest and burn it.

ŒTA COMPTA, Clemens.—*Larva.*—Average length when full grown 0.95. Slender, the diameter being 0.09. General color very dark olive-brown An extremely fine pearly-white dorsal and subdorsal line, and a somewhat more distinct stigmatal line of the same color; all three of them formed by minute white specks and lines. Dorsum, dull olive-green. A longitudinal line somewhat darker and in many cases quite black, below the subdorsal line. Between this last and stigmatal line is a stripe of the same color as dorsum, but speckled with white. Immediately below stigmatal line, it is rusty-yellow, especially on the middle segments. Venter sometimes olive-green, sometimes lead-color, finely speckled with white, and with a translucent line visible along the middle. This larva is mainly characterized, however, by a number of minute white piliferous spots, in strong contrast with the dark body, each giving forth a stiff white hair at right angles from said body. These spots are thus arranged on each side of every segment: 2 about the middle on subdorsal line; 1 under the anterior of these, just below the longitudinal dark line; 2 on the stigmatal line, with the stigmata which is of the same color between them; 1 in the orange part posteriorly; 2 small ones just below the orange part, and 2 in the middle of venter on the legless segments. Head of a beautiful brown, perpendicular, marked with black and speckled with white, two large spots being especially noticeable on the upper front. Cervical shield velvety-black, irregularly speckled with white. Thoracic legs black; abdominals extremely small and of the same color as venter; anals somewhat larger and brown.

Described from numerous specimens. The white spots are usually larger near the head while the hairs springing from them lean towards the head. The head itself is sometimes entirely black, while the white longitudinal lines are occasionally almost obsolete.

The young worm is pale and void of markings.

Chrysalis.—Average length 0.53. Not polished, but with the markings of the larva still apparent through the thin skin. General color dull smoky-brown, with a distinct broad dorsal band of a

light rust-brown color along the abdomen, and a perfectly round spot of the same color on the top of the thorax, this spot generally giving forth a narrow orange line posteriorly.

Perfect Insect.—Average length 0.55; alar expanse 1.08. Fore wings bright lustrous golden-orange, crossed transversely with irregular bands of sulphur-yellow spots on a black ground as in the figure; fringes dense, narrow and brown. Hind wings smoky black, sub-hyaline except near apex and along margins; veins dusky, fringes also. Under surface of front wings dusky brown with the colors of the upper surface partly visible; under surface of lower wings concolorous. Head black with sulphur-yellow tufts; eyes black; palpi alternately black and sulphur-yellow; antennæ filiform, slightly serrate, black with a white shade along the upper terminal third. Thorax black with a wavy sulphur-yellow collar, golden-orange shoulder-covers with a spot of the same color between them, and two sulphur-yellow spots below this last. Abdomen steel-blue above, with a large brimstone-yellow patch on each segment below. Under surface of thorax black with brimstone-yellow patches; legs black, the front pair with yellow *coxæ* and orange thighs, the other four with more or less yellow, especially on the thighs.

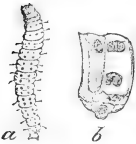
Described from numerous specimens. No particular sexual difference, except in the form of the body.

THE WALNUT TORTRIX, *Tortrix Rileyana*, Grote—Pl. 2, Figs. 3 and 4.

(Lepidoptera, Tortricidæ.)

During the month of May large bunches of the leaves of the Black Walnut and of the Hickory may be found drawn together by a silky web, and living within these bunches, a nest of caterpillars of a yellow color and marked as at Figure 85, *a; b* showing a side view of one of the segments. During the latter part of the month they change to little honey-yellow chrysalids, within the nest, and by the middle of June these last work their way through the leaves to the outside, by means of rows of minute teeth which they have on the back. Here they hang in great numbers by the tips of their abdomens, and in a short time the moths escape.

[Fig. 85.]



a *b*

This moth is represented at Plate 2, Figure 3, with the wings expanded, and at Figure 4 with wings closed. It is prettily marked, the fore wings being of an ochreous color with a golden tint, and darker spots, and the hind wings of a deep golden color. It was first described by Mr. Grote, of New York, in the Transactions of the American Entomological Society, Vol. II, p. 121. It was quite common in 1868 along the Iron Mountain road, and seems to be peculiar to Missouri. It also seems to prefer the young Hickories and Walnuts to the older or larger trees, as I found few nests that were out of reach.

On the Snowberry * (*Symphoricarpus vulgaris*), similar nests may be found at the same time of year, containing caterpillars agreeing in description with those feeding on the Walnut and Hickory, except in being smaller. They go through their transformations in the same manner and produce moths similarly marked but uniformly

* They also occur on the Ironweed (*Vernonia fasciculata*), though I have not bred the moth from worms feeding on this plant.

paler in color, of smaller size and with less contrast between the upper and lower wings. We have here an excellent illustration of what Mr. Walsh has called Phytophagic variation,† for the Snowberry and Hickory feeding worms were evidently of but one species, and the difference in the moths was caused in my estimation by the difference in food. Mr. Grote, it is true, describes the small form as the male and the large form as the female, but the difference is not sexual, as the two sexes occur alike in both forms.

TORTRIX RILEYANA, Grote—*Larva*—Length, Hickory feeding, 0.60-0.80; Snowberry feeding, 0.40-0.50. Largest on segment 2, tapering thence gradually to anus. Ground color dull yellow. Covered with large, distinct, black, sealing-wax-like, slightly elevated spots, each giving rise to several fine bristles. These spots are thus arranged on each segment: 2 each side of dorsum the posterior ones widest apart; 1 at sides in the middle of the segment, containing the stigmata in its lower hind margin; 1 smaller and narrower just below this, on a somewhat elevated longitudinal ridge, and 1 round one below this ridge on the posterior part of the segment. Segments 2 and 3 have but one spot each side of dorsum. Two distinct wrinkles on all the segments, more on 2 and 3. Head, cervical shield and caudal plate black. Venter dirty yellow with black marks; legs ditto.

Chrysalis—Honey-yellow, robust in the middle, and with two transverse rows of minute teeth across the back of each segment.

Perfect Insect—From Hickory—Average expanse 1 inch, length of body, 0.35. Deep ochreous. Fore wings evenly washed with purplish, leaving the fringes and costal edge dark ochreous. The markings take the shape of dark velvety brown rounded maculations, generally of small size and faintly shaded with ochreous on the edges. Three of these subterminally at the base of the wing, subequal, situated interspaceally between the nervures. At a little within the middle of the costa are two fused maculations, the most prominent. Before and beyond these, some faint costal marks. At the extremity of the discal cell, above median nervure, is the first of a series of maculations, normally four in number but not constant, usually uneven in size. A subterminal series of spots is inaugurated on costa by a large, compound shaded maculation. Below this, over the median nervules, sweeps an outwardly rounded series of small approximate dots. Two dots on costa, within and at the apex, and a faint terminal series of minute streaks is shortly discontinued. Hind wings of a lustrous bright deep ochreous; pale along the costal margin and darker shaded along internal margin. Beneath, as are the hind wings above; both wings immaculate, fore wings the darker. Body and appendages concolorous, bright deep ochreous. Antennæ simple. Numerous bred specimens.

From Snowberry—var. symphoricarpi—Much paler, the fore wings not being as dark as the hind wings of the above. The upper surface of fore wings not washed with purplish but merely of a darker ochreous than the hind wing. The maculations entirely similar but ferruginous, paler and the slighter costal marks obsolete. Legs at base and under thoracic surface almost whitish Average expanse, 0.62; length of body, 0.30. Described from numerous specimens. Under surfaces exactly alike in both varieties.

THE SEED-CORN MAGGOT, *Anthomyia zeas*—N. Sp.—Pl. 2, Fig. 24.

(Diptera Muscidæ.)

DESTROYING THE SEED AFTER IT IS PLANTED.

About the 20th of last June I received the following letter from A. S. Fuller, of Ridgewood, New Jersey:

"DEAR SIR: I send you, by mail, a small box containing kernels of sprouted corn, upon which you will find small white worms. Some of the corn fields in this vicinity are being ruined by this pest. These worms attack the corn before it comes up. What are they?"

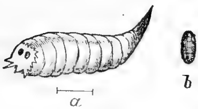
---

† See his paper in Proc. Phil. Ent. Soc., Vol. V, p. 194-216.

Subsequently I was informed that the seed-corn in other fields in Bergen county, New Jersey, was being destroyed in the same manner. The cause of this destruction is a footless maggot, measuring 0.25 to 0.30 of an inch in length, of a yellowish-white color, blunt at the posterior and tapering at the anterior end. It is a new foe to corn, and it is to be hoped that it is confined to the localities above mentioned. In order that it may at once be recognized, I give the following brief account of it:

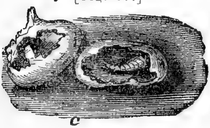
This maggot is shown, enlarged, at Figure 86 *a*, the hair line underneath giving the natural size. It greatly resembles the Onion maggots, which are known to attack the onion in this country, and its work on corn is similar to that of this last named maggot on the onion; for it excoriates and gnaws into the seed-corn, as shown at Figure 87, and finally causes such seed to rot.

[Fig. 86.]



After having become full fed, these maggots usually leave the kernels for the surrounding earth, where they contract into smooth, hard, light-brown pupæ, of the size and form of Figure 86 *b*, and in about a week afterwards the perfect fly pushes open a little cap at the anterior end, and issues forth to the light of day. In this state it is a two-winged fly belonging to the order Diptera, and quite inconspicuous in its markings and appearance. Though I bred but two females, and this sex fails to exhibit some of the most important generic characters, yet there is nothing in the females of this species to distinguish it from the genus *Anthomyia* proper, of Meigen, as restricted by Macquart, and this Corn maggot, therefore, belongs to the same genus as the imported Onion fly (*Anthomyia ceparum*, Meigen). Upon submitting a specimen, for inspection, to Dr. Wm. Le Baron, of Geneva, Illinois, who has paid especial attention to our two-winged flies, he informed me that it is distinct from any hitherto described North American species, and I have, therefore, called it the Corn Anthomyia (*Anthomyia zeas*).

[Fig. 87.]



ANTHOMYIA ZEAS ♀, N. SP. (Pl. 2, Fig. 24). Length 0.20; alar expanse 0.38. Antennæ black; style mircoscopically pubescent; front, fulvous, with a distinct, rather narrow, brownish, cinereous margin; face and orbits brownish-white; palpi and proboscis black; ocellar area somewhat heart-shaped; thorax and abdomen pale yellow-brownish cinerous, with minute black points at the insertion of the bristles; thorax with an indistinct middle stripe of brown; legs black, tinted with cinereous; poisers pale orchre-yellow; scales small, the upper valve larger than the lower.

It is difficult to suggest a remedy for this pest, as its presence is not observed till the mischief is done. Hot water has been found effectual in killing the Onion maggot, without injuring the onions, and would doubtless prove as effectual for this Corn maggot, where a few hills of some choice variety are attacked, which it is very desirable to save. But its application in a large field, even if one knew where to apply it, would be impracticable, and I can only suggest soaking the

seed, before planting, in gas-tar or copperas, and hope that the experiment will be tried next spring by those of our Eastern friends who have suffered from this maggot.

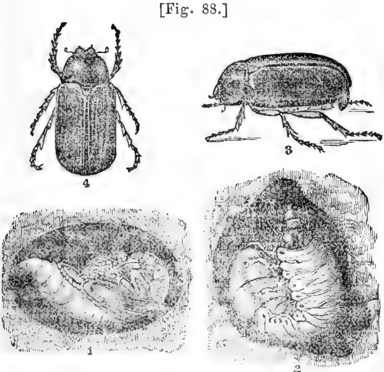
The larvæ of the genus *Anthomyia* live, for the most part, on vegetable matter, and seem to prefer it in a state of decay. Some, however, breed in excrement. Besides this corn species and the onion maggot already spoken of, there is one in this country that attacks radishes, and another that attacks the stem of cabbages. Specimens of this last species have been sent to me by Professor A. N. Prentiss, of Michigan Agricultural College, with the statement that they were proving very injurious to this esculent, around Lansing, in that State, and the flies produced from them seem to be identical with the species that attacks the cabbage in Europe (*Anthomyia brassicæ*, Bouché).

THE WHITE GRUB.

Larva of the May-beetle, *Lachnosterna quercina*, Knoch.

(Coleoptera, Melolonthidæ.)

[Fig. 88.]



The "White Grub is one of the very worst and insidious of the farmer's foes. To give its metamorphoses at a glance, and to obviate the necessity of verbal descriptions of so common an insect, I have prepared the annexed figure (88) which illustrates the full grown larva (2), the pupa (1), and side and back views of the beetle (3 & 4).

The following letter from Mr. Jno. P. McCartney, of Cameron, is a sample of numerous accounts of its depredations which I have received during the year.

"CAMERON, MISSOURI, Sept. 21, 1868.

"MR. C. V. RILEY, *Dear Sir:* The White grub worms have done us in this part of the State a great deal of damage. Will you please give us a history of the insect's habits. The grubs are now full grown, fine fat fellows. Two years since (1866), during the last of May, the beetles were very plenty. After sundown they came in great numbers and swarmed around the tops of the trees on the lawn, making a noise like the coming up of a storm of wind and rain. Last year (1867), the grubs did but little damage. What we want to know is, when will they leave the ground again as beetles? If they spend another summer in the ground it will be of but little use to try and

raise a crop on the land that is now full of them. They have ruined all the meadow in tnis vicinity."

It is characteristic of the beetle to appear in vast swarms during the month of May—earlier or later, according to season or latitude. The beetle is quite voracious, and often greatly injures both fruit and ornamental trees. I have known the Lombardy poplar to die, in consequence of the utter denudation they caused; while last June certain groves of both Pin and Post oaks on the farm of Mr. Flagg, of Alton, Illinois, were so thoroughly and suddenly denuded by them, that Mr Flagg could not at first divine the cause. Their existence in the beetle state is however short, and as they are confined to the foliage, their injuries are exceedingly small compared with those which their larvæ inflict upon us. Our meadows, strawberry beds, corn, vegetables, and even young nursery stock, are all subject to the attacks of these White grubs, and often ruined by them. Soon after pairing, the female beetle creeps into the earth, especially wherever the soil is loose and rough, and after depositing her eggs, to the number of forty or fifty—dies. These hatch in the course of a month, and, the grubs growing slowly, do not attain full size till the early spring of the third year, when they construct an ovoid chamber, lined with a gelatinous fluid; change into pupæ, and soon afterwards into beetles. These last are at first white, and all the parts soft as in the pupa, and they frequently remain in the earth for weeks at a time till thoroughly hardened, and then, on some favorable night in May, they rise in swarms and fill the air.

This, is their history, though it is very probable, as with the European Cock-chafer (a closely allied species), that, under favorable conditions, some of the grubs become pupæ, and even beetles, the fall subsequent to their second spring; but growing torpid on approach of winter, remain in this state in the earth, and do not quit it any sooner than those transformed in the spring. On this hypothesis, their being occasionly turned up in the fresh beetle state at fall plowing, becomes intelligible.

Remedies.—As natural checks and destroyers of this grub, may be mentioned the badger, weasel, skunk, marten, the crow, and the different hawks, but especially the Ground beetles among insects, some of which have been figured on page 115. Hogs are fond of them, and a gang may be turned into an infested meadow, which is to be cultivated the next year, with good advantage. The grub sometimes so thoroughly destroys the roots of meadow grass that the sward is entirely severed; in such cases a heavy rolling would doubtless kill great numbers of them. Applications of ashes and salt have been recommended, but I think they are of doubtful utility, unless sufficiently applied to saturate the ground to the depth of more than a foot. A field or meadow is badly injured during a certain year by the full grown grubs. The following spring the owner, ignorant of the insect's history, applies some substance to the land as a remedy, and finding no grubs during

the summer following, will naturally conclude his application was effectual, when in reality the insects left of their own accord in the beetle state.

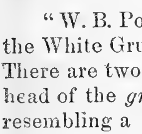
During their periodical visits as beetles, they should be shaken from the trees, gathered up, scalded and fed to hogs. As an illustration of what may be done in the way of hand-picking, I will state that under the efforts of M. Jules Reiset, the incredible amount of 160,000 kilogrammes, or about eighty millions of similar White grubs were collected and destroyed in a portion of the Seine-Inferieure of France, during the autumn of 1866.

The beetles make their appearance in different localities with great regularity every three years, and in a case like that communicated by Mr. McCartney, I should advise him to plant freely next spring without fear of their ravages; for he may rest confident that they will issue as beetles next spring and not be very troublesome again, as grubs, till the summer of 1871. At Unionville, according to Mr. A. L. Winchell, the beetles appeared "in millions" last spring, and I hope soon to be able to give the years in which they will appear in the different localities throughout the State. The White Grub is subject to the attack of a curious fungus, which the following item from the Sedalia, Pettis county, *Press* very well describes:

"W. B. Porter, of this county, has left at our office a specimen of the White Grub, so formidable as a corn, potato, and grass destroyer. There are two sprouts of green, vegetable growth, growing out of the head of the *grub*, one on either side, of nearly half an inch in length, resembling a hog's *tusk* in shape. Mr. Porter informs us that the one presented is by no means an isolated example, but that myriads of them can be found which present the same anomalous combination of animal and vegetable life. Who will explain this aberration from the well settled laws of organic life?"

In the second volume of the late *Practical Entomologist*, page 16, an account was given of the same fungus, great numbers of the grubs on Mr. Paulding's place at Tipton, Iowa, being affected with it. Dr. Kirtland, of Ohio, also evidently refers to the same fungus as being well known to science in the *Prairie Farmer* for 1865, Vol. XVI, p. 71. At Figure 89, I represent one of the grubs as it appears when attacked by this fungus, drawn from specimens received from Mr. Porter. The sprouts are almost invariably two in number and proceed from the corners of the mouth, but in one specimen which I have, there is but one near the mouth, the other protruding from the middle of the back.

[Fig. 89.]



In Virginia the grub seems to be attacked by another fungus, as the following letter of Mr. Sam. H. Y. Early, which was communicated to Mr. Walsh by the well known Entomologist, Wm. H. Edwards, abundantly shows:

"There is a white mushroom known in the region in which I was raised, as poisonous and fatal to the hogs that feed on it. I believe it is common in all localities in which I have been. In the spring of 1842 I observed in what is called a 'new ground' in Virginia a great quantity of these mushroom, and in reply to some remark I made about them, some of my father's negroes. who were then making hills with hoes for planting tobacco, inquired of me if I knew what produced these mushrooms. On my replying in the negative, I was informed that they grew from the White grub worm. I think there were some twelve or fifteen negroes present, all of whom curcurred in the statement, and said it was no new thing to them. They had no difficulty in establishing the truth of what they stated, because they dug them up in all their stages of germination and growth before my own eyes. In a very short time they had furnished me with a large number of the worms in their original shape, features and size, and as distiuct to the eye as if they had been alive, but having the consistency, color and smell of a mushroom; and I actually broke them up, just as a mushroom breaks in one's hands, snapping them crosswise and sqarely off. Many others I found to be enlarged before germinating, and many just germinating, but with the shape of the worm preserved. And in some I noticed that the features of the worm were preserved in the root, even after the mushroom had grown up through the earth and attained some size. I gathered a good many specimens in their various stages into my handkerchief, and carried them to my father's house, where they lay on the mantel for some time. They seemed, however, to be no novelty to many to whom I exhibited them. In fact they were familiar to almost all who had opportunities of investigation, and to whom I mentioned them at the time."

Whether there is any relation between these two fungoid growths further investigation will alone tell; but when we shall have become better acquainted with them we may possibly be able, by sowing the spores of either kind to effectually kill the White Grubs in our fields.

THE AMERICAN MEROMYZA—*Meromyza Americana*, Fitch.—Pl. 2, Fig. 28.

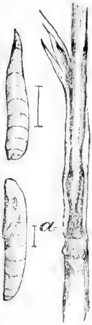
(Diptera Muscidæ.)

ATTACKING WHEAT.

About the middle of the month of June last, in all the wheat fields which I examined between Bluffton on the Missouri river and St. Louis, I noticed that a great many of the ears had prematurely ripened, had turned yellow and were stunted and shorter than the rest, and upon examination the kernels proved to be withered and shrunken.

In most fields about one per cent of the ears were thus affected, but in two fields near Hermann, from three to four per cent were injured in this manner. This appearance was variously attributed to Hessian fly, Midge, etc., etc., no one seeming to know the true cause. Upon examination I found that the last or ear-bearing joint could invariably be pulled out of its sheath with but a slight effort, and that it was perfectly yellow and dry, while the lower end bore an irregular and gnawed appearance. Upon splitting open the first joint of the stalk, a space of about a quarter of an inch was found to be completely corroded, so to speak, and filled with excrementitious matter, as shown at Figure 90. *a*. In this space would generally be found a pale watery-green maggot of the form of Figure 90, *b*, attenuated at one end and blunt at the other. I took a number of infested stalks home, and many of the maggots changed to green pupæ of the form and appearance of Figure 90, *c*. Before changing to pupa the maggot would sometimes crawl away from the joint and get nearer the head, between the stalk and the sheath. The pupa state lasted from 12 to 14 days, and the first flies emerged during the first week in July.

[Fig. 90.]



This fly is represented, magnified, at Plate 2, Figure 28, and belongs to the genus *Meromyza* in the family MUSCIDÆ of the order DIPTERA. It appears to be the very same species which Dr. Fitch found flying about wheat fields in New York State, and which he described and named as the American Meromyza (*Meromyza Americana*), on page 299 of his 1st and 2d Reports.* He did not ascertain the habits of the larva, however, and they have ever since remained unknown. The fly measures, on an average, 0.17 to the tip of the abdomen, and expands about 0.20. It is of a pale yellowish-green, the head being more inclined to straw color. The eyes are black and there is a round black spot between them on the top of the head. There are three broad black stripes, with a bluish-gray cast, on the thorax, the middle one straight and extending anteriorly to the pedicel of the neck, the outer ones slightly rounded outwardly, not extending so far anteriorly, but extending around the scutel and joining the middle one posteriorly. The abdomen also has, above, three broad blackish stripes, which are confluent posteriorly and interrupted at each of the sutures. Wings prismatic, hyaline and greenish anteriorly, their veins and the tips of the feet being dusky.

In Europe the larvæ of the closely allied genera *Chlorops* and *Oscinis* have long been known to attack some part or other of the stalks of wheat, rye, barley and other small grains. Several species are figured and described by the English Entomologist Curtis in his

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* My specimens are all somewhat smaller than Dr. Fitch's according to his description, and have black eyes instead of "bright green;" but upon submitting specimens to Baron R. Osten Sacken who makes a specialty of *Diptera* he referred it to the same species.

"Farm Insects," and one of them—the *Oscinis vastator*—though a very different fly, seems to have almost precisely the same habit as our insect. It is quite probable, also, that in this country as in Europe, there are two broods during the year, the second brood of larvæ attacking grain sown in the fall, but further investigation alone will decide these points.

. REMEDIES.—Much can be done in an artificial way by cutting off and destroying all the infested stalks, which may readily be recognized by the signs already described; but even if this plan should faithfully be carried out, it is doubtful whether it would pay in a country where labor is so scarce and demands such high wages as in ours. We therefore have to fall back on the only practical means within our reach, viz: that of varying the culture by alternate courses, and this style of cultivation will have to be more generally adopted, should this pigmy foe sufficiently increase as to greatly diminish the yield of the "staff of life." There is every reason to believe, however, that Nature has her own means of keeping these flies within due bounds, for they are known to be preyed upon by parasitic Ichneumon flies in Europe, and I noticed many flies of this last description, of polished hues and active movements, deftly darting through, and resting upon the wheat plants of the fields infested with the *Meromyza.*

THE SHEEP BOT-FLY OR HEAD MAGGOT—*Œstrus ovis*, Linn.

(Diptera, Œstridæ.)

[Fig. 91.]

For the benefit of sheep raisers I give the following brief account of the insect which causes "Grub in the head." The annexed illustration (Fig. 91) represents it in all its stages. 1 shows the Gadfly, life size, with wings closed; 2 the same with wings expanded; 3, the pupa from which the fly has escaped; 4 the full grown larva, dorsal view; 5 the same, ventral view; 6 the same when younger.

This insect is the dread of sheep in the Old as well as the New World, and was made mention of by the Greek physician, Alexander Trallien, as far back as the year 560.

The flies make their appearance in June and July, and deposit living maggots in the nostrils of the sheep. As soon as they are deposited they ascend the nostrils, causing great irritation on their way, until they reach the frontal sinuses; there they attach themselves by

the little hooks or tentacula placed each side of the head, to the membranes which line the cavities, feeding on the mucus which is always to be found in them. Until they attain their growth they are of a creamy white color, with two brown spots placed side by side on the posterior segment. These spots, (6, *c*) are spiracles or stigmata, through which the worm breathes. The segment with these two spiracles, is retractile, and can be drawn in and hidden at the worms pleasure. When full grown, the grub becomes darker, particularly towards the tail, the white of the first two or three segments becoming dirty white on the 4th or 5th, and growing darker on each successive segment until the last, which is of a very deep brown. It has two small parallel hooks or tentacula at the head (*a*), and above these, two very small tubercles, not very easily shown in the engraving. It also has a small brown elevated round spot on each segment along the sides, which might at first be taken for spiracles but which are not, and also two small corneous appendages (5, *b*) on each side of the anus. The ventral region has a band of small elevated dots running the breadth of each segment in their middle, which, under the magnifier appear to be minute brown spines, all pointing posteriorly. (See Fig. 91, 5). These aid the worm in its movements.

When ready to contract into a pupa, it descends down the nostrils of the sheep and falls to the ground, where it quickly buries itself and in about 48 hours, contracts to half its former size, and becomes smooth and hard and of a black color, tapering as in the larva towards the head. It remains in this state from 40 to 50 days, or more, according to the weather, when the fly pushes open a little round cap-piece at the head and thus arrives at maturity.

In this stage it looks something like an overgrown house-fly. The ground color of the upper part of the head and thorax is dull-yellow, but they are so covered with little round elevated black spots and atoms (scarcely distinguishable without the aid of a magnifier) that they have a brown appearance. The abdomen consists of 5 rings, is velvety and variegated with dark brown and straw color. On the under side it is of the same color, but not variegated in the same way, there being a dark spot in the middle of each ring. The feet are brown. The under side of the head is puffed out, and white. The antenæ are extremely small and spring from two lobes which are sunk into a cavity at the anterior and under part of the head. The eyes are purplish brown, and three small eyelets are distinctly visible on the top of the head. It has no mouth and cannot therefore take any nourishment. The wings are transparent and extend beyond the body, and the winglets, which are quite large and white, cover entirely the poisers. Its only instinct seems to be the continuation of its kind. It is quite lazy, and except when attempting to deposit its young, its wings are seldom used.

It has lately become the fashion with many members of the Agricultural press, to ridicule the idea that sheep die at all from grub in

the head, and many even deny that the grub is capable of any injury to the sheep whatever. From the fact that this grub may be found in the head of almost every sheep that dies, in the Western States at least, it is undoubtedly true that many other diseases are cloaked by the popular verdict of "grub in the head." It is none the less true, however, that those Agricultural editors, who pretend to instruct, simply show their lack of practical knowledge, in butting against that which must be the firm conviction of every flock master, viz: that sheep do die *of* grub in the head, Messrs. Youatt and Clark notwithstanding.

Mr. Youatt declares: "It is incompatible with that wisdom and goodness that are more and more evident in proportions as the phenomena of nature are closely examined, that the destined residence of the *Œstrus ovis* should be productive of continued inconvenience or disease." I agree most decidedly with Mr. Randall, that "this is as far fetched as a conclusion, as the reasoning on which it is founded."

If grub in the head is not productive of inconvenience or disease, as the disciples of Youatt have it, whence the suffering condition, the loss of appetite, the slow, weak gait, the frequent coughing, the slimy and purulent matter, sometimes so profusely secreted as at times to almost prevent the animal breathing? Whence the tossing and lowering of the head, and the fits of frenzy, to which so naturally quiet and gentle an animal as the sheep is subject? All these symptoms result from grub in the head, and the animal frequently gets too weak to rise, and finally dies. These effects of the grub were well recognized and understood by such old writers and close observers as Reaumur and Kollar; while Mr. Dan'l Kelly, of Wheaton, Illinois; Towne Bros., of Geneva, Illinois; M. L. Cockrill, of Tennessee, and other well known flock-masters with whom I have either conversed or corresponded, are unanimous in ascribing these symptoms to the true cause; and the late S. P. Boardman, of Lincoln, Illinois, coincided with them in this respect. For my part, I would as soon believe that those parasites were beneficial, which are so injurious to man, either internally or externally, or those which prey upon our caterpillars and other insects, and invariably destroy them; for although, when there are but few grubs in the head, the injury they inflict is not perceptible, *they can never be beneficial*, and when numerous enough will undoubtedly cause death. They cannot live in the head of the sheep without causing great irritation by the spines with which the ventral region is covered and the hooks with which they cling to such a sensitive membrane as that which lines the sinuses. Moreover, when numerous enough to absorb more mucous than the sheep secretes, the grubs will feed on the membrane itself, and (according to the evidence of some practical sheep men) will even enter to the brain through the natural perforation of the ethmoid bone, through which pass the olfactory nerves; in either of which cases, they must cause the most excruciating pain. The natural fear

also, which sheep have of the fly, and the pains they take to prevent its access to the nose, is of itself proof enough that it is obnoxious to them. The rabbit is subject to the attack of a very large gad-fly (the *Cuterebra caniculi* of Clark). I saw a half grown rabbit the past summer with an enormous swelling each side of its neck. On examination these swellings were found to be caused by the grubs of this fly, and the rabbit was so weakened and emaciated that it could scarcely move. No one could witness such a sight without being convinced that the parasite was injurious.

In the *Prairie Farmer* of October 14, 1865, the fact was published that the Sheep Bot-fly deposits *living* maggots in the nostrils of the sheep. It was published on the authority of Mr. Kelly, and both he and myself then believed it to be the first published account of the viviparous nature of this fly. But the following extract from a letter from the late lamented Samuel P. Boardman, of Lincoln, Illinois, shows that the same discovery has been made by three independent observers in this country. Mr. Boardman wrote as follows:

"All the authors, both European (at least all *English*) and American, from Youatt to Randall, will persist in saying that the fly deposits *an egg*, which hatches out, and crawls up the nostrils of the sheep, etc., etc. Now three independent and perfectly original discoverers have in our own country within twenty-five years past, disproved the book account of the grub's transformations.

"John Brown—'Old Ossawattomie John Brown,'—published an account in an Agricultural paper (I forget what one) about twenty years since, of his seeing, 'with his own eyes,' the fly drop the *perfectly formed and living grub* in the nostrils of sheep. Some seven years since, 'Old Dan Kelly,' of Du Page county, Illinois, made the same discovery and supposed that he was the only man who had ever done it. At the time he made known his discovery, at a meeting of the Illinois State W. G. Association held in Chicago, I thought also, that he was the first man to ever notice the like. Two or three years afterwards I saw the account of John Brown's discovery, in the *Ohio Farmer*, copied from an old paper dated about seventeen years previously. When Kelly and I were at the meeting of the National W. G. Association, I went with him to the *Ohio Farmer* office, and I found in the file, Old John Brown's account. Mr. Kelly took a copy of the *Farmer* containing it, home with him. That makes *two* perfectly original and independent discoveries of the fact alleged. Now then, within a year past (I think) I have seen a letter from Mark Cockrill, of Tennessee, (who, before the war, was one of the oldest, largest and richest wool growers in the South, as well as one of the richest men in the South), in which he speaks of having made the same discovery years ago, and in which he speaks of it as if he thought he was the only, and original discoverer. Here are three men widely separated, who, we must acknowledge, are all capable and honest observers, and yet, Randall, (or at least his publisher) continues to put

forth in every new edition of the '*Practical Shepherd*,' the same old exploded (or should be) notion of the fly depositing *an egg*. I presume it is altogether likely that all modern English writers on sheep keep up the same thing—by copying from Youatt."

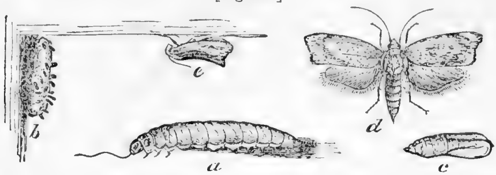
On one occasion in 1866, I myself obtained living maggots from one fly and Mr. Cockrill has since obtained over 300 living, moving worms from one that was caught while she was after the sheep. Many flesh-flies, if they cannot find suitable meat or carrion on which to lay their eggs, retain these egg so long in their bodies that they hatch there, into living larvæ; and it is not impossible that the above observations were made with flies that had been so circumstanced, but I think it highly improbable, and strongly incline to believe that it is the normal nature of this fly to produce living larvæ. I incline to this belief the more strongly, from the fact that it would be difficult to attach an egg to the slimy nostrils of a sheep.

To prevent it from depositing its young, different means are resorted to. Mr. Randall says that "some farmers turn up the soil in portions of their pastures, so that the sheep may thrust their noses into the soft ground, on approach of the fly, while others smear their noses with tar, or cause them to do so themselves." But as the fly is very persevering, and generally attains her object, the means to be depended on the most, is the dislodging of the larva, or "grub," and so far, lime has been thought to be the most effectual, and should be given them, that they may by sniffing it, cause sneezing, and in many cases dislodge the grub. Some sheep keepers even shut their sheep up for several nights, in a tight barn, when first taken up in the fall, believing that the close and heated atmosphere induces the grub to descend, and is therefore more readily dislodged, and that the injury accruing from such foul air, is trifling, compared with the benefit received by dislodging the grubs. Other sheep breeders are in the habit of fixing salt logs in their pastures, of sufficient length to enable all the sheep to get at them. Into these logs, at distances of five or six inches, holes are bored with a two-inch auger, and during fly season a little salt is kept in these holes, while every two or three days tar is smeared around them with a brush. The sheep in obtaining the salt, tar their noses, and the odor of the tar keeps the fly away. In severe cases where the grubs are already in the head, they may be dislodged in a measure, by a feather dipped in turpentine, which should be run up the nose and gently turned.

INSECT ENEMIES OF THE HONEY-BEE.

THE BEE-MOTH OR WAX-WORM,—*Gallerea cercana,* Fabr.

[Fig. 92.]



Large hawk-moths sometimes enter a beehive for what honey they can get, and even mice have been known to enter a hive; while several parasites live upon the bees themselves. In our own State as I shall presently show there is a large two-winged fly which seizes the bee while on the wing and kills it. But by far the worst enemy the bee-keeper has to contend with, is the Bee-moth (*Galleria cereana*, Fabr). This insect is so well known to bee men generally, that it scarcely needs a description. It is well illustrated above (Fig. 92) in all its stages, *a* showing the full grown worm, *b* the cocoon which it spins, *c* the chrysalis to which it changes, *d* the female with wings expanded, and *e* the male moth viewed from the side with the wings closed. It suffices to to say, that the color of the moth is dusky gray, the fore wings which are scalloped at the end, being more or less sprinkled and dotted with purple-brown. The female is generally a good deal larger than the male, though there is not so much difference between the sexes as some writers have supposed. The worms which produce these moths are of an ash-gray color above, and yellowish-white beneath.

The Rev. L. L. Longstroth, in his excellent work on the Honey-bee, which every bee-keeper should possess, has given such a complete account of the Bee-moth, that it is only necessary for me to mention a few of the most important facts with regard to it, my object being principally to show that there can be no such thing as a *moth-proof hive*; that wire-gauze contrivances are of no avail, and that the man who pretends to sell a moth-proof *hive*, may usually be set down as a know nothing or as a swindler.

The Bee-moth was first introduced into this county from Europe, about the commencement of the present century, and it was in all probability imported with the common bee-hive. There are two broods of the moth each year, the first brood appearing in May and June, and the second, which is the most numerous, in August. During the day time, these moths remain quietly ensconced in some angle of the hive, but as night approaches, they become active, and the female uses her best endeavors to get into the hive, her object being to deposit her eggs in as favorable a place as possible. Wire-gauze contrivances are of no avail to keep her out, as she frequently commences flying before all the bees have ceased their work. But even if she were entirely prevented from entering the hive, she could yet

deposit her eggs on the outside, or by means of her extensile ovipositor, thrust them in between the slightest joint or crack, and the young worms hatching from them, would readily make their way into the hive. The moment the worm is hatched, it commences spinning a silken tube for its protection, and this tube is enlarged as it increases in size. This worm cuts its channels right through the comb, feeding on the wax, and destroying the young bees on its way. When full-grown, it creeps into a corner of the hive or under some ledge at the bottom, and forms a tough white cocoon, of silk intermingled with its own black excrement as in figure 92, *b*. In due time the moth emerges from this cocoon.

A worm-infested hive may generally be known by the discouraged aspect which the bees present, and by the bottom-board being covered with pieces of bee-bread mixed with the black gunpowder-like excrement of the worm. It must not be forgotten, however, that in the spring of the year, pieces of bee-bread at the bottom of a hive *when not mixed with the black excrement*, is not necessarily a sign of the presence of the worm, but, on the contrary, may indicate industry and thrift. If a hive is very badly infested with the worm, it is better to drive out the bees and secure what honey and wax there may be left, than to preserve it as a moth-breeder to infest the apiary. If put into a new hive, the bees may do something, and if they do not, there is no loss, as they would have perished, finally, from the ravages of the worm.

It should invariably be borne in mind that a strong stock of bees is ever capable of resisting, to a great extent, the attacks of the worm; while a starved or queenless swarm is quite indifferent to its attacks. In a common box hive, a good way to entrap the worms after they are once in a hive, is to raise the front upon two small wooden blocks, and to put a piece of woolen rag between the bottom-board and the back of the hive. The worms find a cozy place under the rag, in which they form their cocoons, and may there be found and killed, from time to time. Much can be done in the way of prevention, by killing every morning, the moths which may be found on the outside of the hives. At this time of the day, they allow themselves to be crushed, with very good grace; and if two or three be killed each morning, they would form an important item at the end of the year, especially when we recollect that each female is capable of furnishing a hive with at least 300 eggs. In conclusion, I give it as my conviction that immunity from the ravages of this Bee-worm can only be guaranteed where a thorough control is had of both hive and bees; hence the great importance of the movable frame hive.

THE BEE-KILLER—*Trupanea apivora*, Fitch.

(Diptera, Asilidæ.)

[Fig. 93.]

In the last chapter of his 9th Report, Dr. Fitch describes a fly by the name of the "Nebraska Bee-killer," which he received from Mr. R. O. Thompson, of Nursery Hill, Otoe county Nebraska, and which the latter named gentleman had found preying upon the bee in North Nebraska in the summer of 1864. Mr. Thompson has since removed from Nebraska to North Missouri, and in conversation with him last summer he informed me that he had met with this Bee-killer each year since 1864, and that it seemed to be increasing. At a later day, in a communication to the *Rural World* of September 12, 1868, he states that it made its appearance in such numbers in North Missouri last summer, that it to a great extent prevented the bees from swarming. I present above at Figure 93 a life-size portrait of this voracious insect, its general color being yellowish-brown or yellowish-gray. This figure will enable its ready recognition, and those who wish a very full and detailed description of it will find it in the Report of Dr. Fitch above referred to. It belongs to the *Asilus* family of two-winged flies which have been very aptly termed the hawks of the insect world. Last July I found thse flies quite common in Mr. Shaw's beautiful gardens in St. Louis, and I watched them by the hour and found to my amazement that though other insects were flying all around, as well as other species of bees, yet they never seized any other species but the common Honey-bee. They capture the bee on the wing, pouncing upon it with lightning-like rapidity; then grasping it securely with their fore legs, they alight upon some plant or even upon the ground, and rapidly suck out the inside of the bee, with the stout and powerful proboscis which is shown in the figure, leaving the empty shell when they get through. Mr. Thompson says that beneath some favorable perch that is near the apiary, hundreds of these bee-shells may be found accumulated in a single day; while he has watched and found that a single fly on one of these perches destroyed no less than 141 bees in that period of time.

The habits of these flies are little known, and until they are better understood no feasible way of protecting the bees from their attacks can be given. Those which are known to haunt the apiary should be captured, and this can best be done by means of a net. It is almost impossible to catch them while on the wing, though as soon as they have settled with their prey they are caught with comparative ease. It will pay to thus catch them for they are doubtless the cause of much of the non-swarming which we hear of.

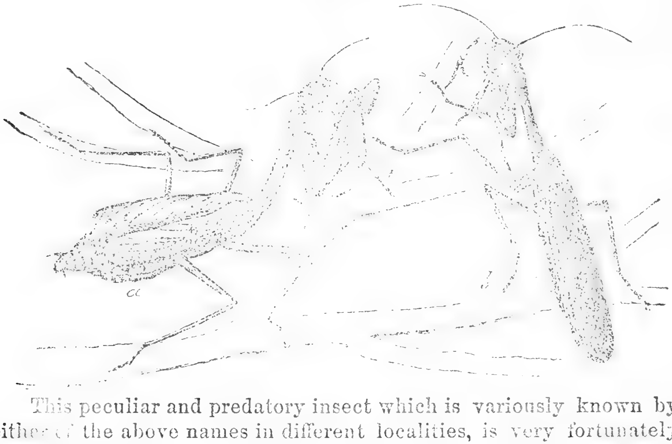
BENEFICIAL INSECTS.

I have already treated of a number of beneficial insects in connection with the insects on which they prey, and under this head I shall, for the present, only say a few words about

THE REAR-HORSE, *alias* CAMEL-CRICKET, *alias* DEVIL'S RIDING HORSE—*Mantis Carolina*, Linn.

(Orthoptera Mantidæ.)

[Fig. 94.]



This peculiar and predatory insect which is variously known by either of the above names in different localities, is very fortunately quite common in the central and southern parts of Missouri, as well as in most of the Southern States. Its food consists mainly of flies, though it is a most voracious cannibal and will devour its own kind as well as any other living insect that comes within its grasp. I have known it to attack various kinds of butterflies, including the male Bag-worm, grasshoppers, and caterpillars of various kinds, and in one instance a single female devoured eleven living Colorado Potato-beetles during one night, leaving only the wing-cases and parts of the legs. It disdains all dead food, and never makes chase for the living, but warily, patiently and motionless, it watches till its victim is within reach of its fore-arms, and then clutches it with a sudden and rapid

motion. Its appearance is really formidable, and its attitude while watching for its prey quite menacing, and on this account it is held in very general and superstitious dread. It is, however, utterly incapable of harming any one; and, as one of our best friends should be cherished and protected.

At Figure 94, above, this insect is represented in the full grown state, *a* showing the female and *b* the male. It will be seen that they differ materially from each other, the male having a long slender body with long wings, while the female has a broad flat body with short wings. Hence, while the male can fly through the air with greater facility than do our grasshoppers, the female is utterly incapable of performing the same feat, and only uses her wings when in battle with one of her own kind, or when pouncing upon her prey, at which time she hoists them very much as a swan hoists his wings when irritated. The difference in the sexes is not apparent till after the third moult, all the young Mantes being very much alike. The general color of the Mantis is grayish-brown though a pale green dimorphous form is quite common. The newly hatched larva is invariably, so far as my observations extend, light yellowish-brown, though I have seen green individuals after the first moult. The green form is almost entirely confined to the female sex, and seems to be the most common color of this sex when full grown; but it is found likewise, to some extent, among the males, as specimens with green legs and partly green bodies are to be met with, though I have never seen a male that was entirely green. About the beginning of August these Mantes acquire wings, and by the middle of September the female commences to deposit her eggs. These eggs are all glued tightly together in a peculiar mass, and are deposited in all sorts of situations, but principally on the twigs of trees. At Figure 95 two of these egg-masses are represented, natural size, the lower mass showing the most common form, the upper mass illustrating how it conforms to the object on which it is placed. These egg-masses are often found by persons in the winter, though very few are able to conjecture what they really are. On cutting them open the eggs are found to be very systematically arranged and to contain a mucilaginous substance of the color of thin glue.

[Fig. 95.]

The manner in which these eggs are deposited has never been described, and though I have never myself witnessed the operation, I have found the mass while it was yet quite soft and freshly laid, and have dissected the female just before she was about to deposit; and incline to believe that it is gradually protruded in a soft mucilaginous state, being covered at the time

with a white, frothy, spittle-like substance which soon hardens and becomes brittle upon exposure to the air. Mr. Parker Earle informs me that he has witnessed the operation, and that he judges it to require about an hour, the eggs being "pumped out, and the entire mass elaborately shaped, with a fine instinct of construction as the process continues."

Between the 10th and 20th of June these eggs hatch into comical-looking little Mantes, in all respects resembling their parent, with the exception that they have no wings; for, with the grasshoppers, crickets, katydids, walking-sticks and roaches, etc., etc., which belong to the same order (*Orthoptera*), they do not undergo any sudden transitions from the masked *larva*, to the quiescent *pupa*, and thence to the winged *imago* state, as do most other insects.

When the young first issue from the egg-mass, they are yet, as with the young of most other *Orthopterous* insects, enveloped in a fine skin which confines their members and prevents free motion. In this condition they look not unlike some of our leaf-hoppers (*Tettigoniæ*,) but as soon as they extricate themselves they begin to show their unfeeling and voracious disposition by attacking and devouring each other. Indeed, those sentimentalists who believe that the worm crushed under foot suffers as much as the man who breaks an arm or a leg, would do well to study the habits of these Mantes. They are so void of all feeling that, the female being the strongest and most voracious, the male in making his advances, has to risk his life very many times, and at last only succeeds in grasping her by slyly and suddenly surprising her; and even then he frequently gets remorselessly devoured. I have seen a female, decapitated, and with her body partly eaten, slip away from another that was devouring her, and for over an hour afterwards fight as tenaciously and with as much *nonchalance* as though nothing had happened.

The eggs may be readily transported from one place to another, and the insect can thus be easily colonized. Mr. Jordon in this way has caused them to increase very much in his home nursery in St. Louis, though he finds some difficulty in protecting the eggs during the winter from the attacks of birds. He considers that as long as he can keep the Mantes sufficiently numerous he will never be troubled with noxious insects.

We know with what fear the hawk is regarded by the great majority of small birds, but that at the same time the common house martin defies and even tantalizes and drives it off. In like manner this Mantis which must be the dread of most flies, is yet defied by a certain class of them, belonging to the same (*Tachina*) family, as that described and figured on page 111, for I have found no less than nine maggots in the body of a living female Mantis, which must have hatched from eggs that had been deposited on her body by one of these flies.

INNOXIOUS INSECTS.

Under this head, I propose to devote a few pages each year to those insects which can neither be considered injurious or beneficial to man, either directly or indirectly. As State Entomologist I feel it my duty to devote my time primarily to the study of those insects that immediately concern the agriculturist, and by thus doing, to save to our great and growing State a portion of that immense sum which is annually lost by insect depredations. At the same time I feel that it will be expected of me to add to our present knowledge of the natural history of the State, by discoveries in my particular branch of zoology. The prosperity of a State does not depend solely on its material wealth, but to a great extent on its mental wealth. KNOWLEDGE—that great interpreter of oracles—moves the world! It enables us to see in the bowels of the unfathomable earth beneath, in the water, in the air, and in the skyey vast above, volumes written by the hand of Omnipotence!

> "To win the secret of a weed's plain heart,
> Reveals the clue to spiritual things,"

And there are few departments of science which offer such food for the mind as does the study of Natural History. It has been truly said that the naturalist has no time for selfish thoughts. Everywhere around him he sees significances, harmonies, chains of cause and effect endlessly interlinked, which draw him out of the narrow sphere of self-lauding into a pure and wholesome atmosphere of joy and felicity.

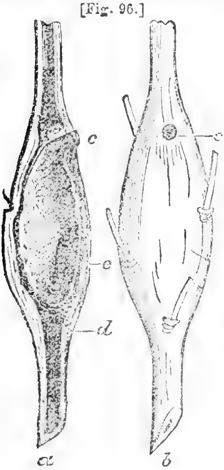
Day by day science is becoming more and more popularized, and before long the necessity of devoting more attention to natural history in our schools and colleges will become apparent. There are few things, for instance, so well calculated to train the minds of children, and at the same time entertain and instruct them as would be a chart illustrating the transformation of insects, and it is with the firm belief that this kind of information will soon be more generally sought for, that I introduce to my readers

THE SOLIDAGO GALL MOTH—*Gelechia gallæsolidaginis*, N. Sp. —Pl. 2, Figs. 1 and 2.

Every body must have noticed the large round galls about the size of a walnut which are found upon the straight smooth stem of the common Golden-rod (*Solidago nemoralis*). There are sometimes two on the same stalk and they are most conspicuous in winter time when the leaves are off the plant. Upon cutting open one of these galls it is found to consist of a pithy solid mass, in the centre of which is a plump white footless maggot. This maggot in due time develops into a two-winged fly, which was long since described by Dr. Fitch as *Trypeta* (*Acinia*) *solidaginis*.

The gall which I am now about to speak of, occurs on the same species of Solidago, and in almost equal abundance with the former, though its architect has never hitherto been described. This gall which is represented at Figure 96, *b*, is of a very different form from the preceding, being altogether more elongate and narrower, and upon cutting it open it is found to be hollow, and to contain, instead of a white footless maggot, a gray 16-footed caterpillar (*e*), which in time develops into the little moth which is represented with the wings expanded at Plate 2, Figure 1, and with the wings closed at Figure 2. The history of this insect may be thus briefly told:

[Fig. 96.]



The moths winter over and may be seen flying in the month of May, in which month I have myself captured a specimen. When the young plants of the Golden-rod are about six inches high the female moth deposits an egg either in the terminal bud, or at the side of the stalk just below it, and the worm hatching from the egg works into the stalk, and causes it to swell by gnawing and thus inducing the secretions towards it. By the beginning of June the gall has just begun to form and at this time upon cutting it open the worm is found to be about $\frac{1}{3}$ grown, and its excrement is as yet all at the upper portion of the gall. As the plant grows, so the gall increases in size, remaining, however, at the same altitude from the ground. By the middle of July both the gall and its maker have attained their full size, and upon opening the former at this season of the year the excrement will be found packed closely at both its ends, and from the small quantity of such excrement (*d*) to be found, it would appear that all but the more solid parts had been absorbed by the plant, it probably acting as a manure to stimulate the growth of the gall. When full grown, the worm measures rather more than half an inch, and it now prepares for changing into the

chrysalis state by eating a perfectly round passage-way entirely through the wall of the gall at its upper end. It then protects the orifice with a secretion of liquid silk which hardens and forms a perfect little plug (Fig. 96, *c*,) about 0 04 thick and 0.08 in diameter, and which is so constructed that it cannot be readily displaced from without, as it has a rim on its outer edge. The inner edge, however, is not so rimmed, and the plug can be pushed away from the inside with the slightest effort, for the little tenant when it shall have become fitted to leave its dark and secluded tenement and soar into the air, must needs make its exit through this orifice. Well may we wonder at Nature's handiwork, for what consummate skill, and wonderful instinct—I had almost said forethought—is here exhibited! Can this action be but a blind instinct, or has the larva a premonition of its future etherial imago state and its wants? Who can answer? Our little host, not satisfied with having thus protected the entrance to his home, now lines its passage way, and the walls, with a delicate silken tissue, after which he rests from his labors, and commences to undergo those mysterious transformations, so characteristic of his class. A gall cut in two at this stage of its growth presents the appearance of Figure 96, *b*. In two days' time the little worm has changed to a chrysalis, just ½ inch in length, rather slender and of a shiny mahogany-brown. At the end of about three weeks more the chrysalis grows very dark, and finally the inclosed moth bursts the skin and escapes from the gall.

The first moths usually appear about the middle of August, but as the time of egg-depositing covers a period of over a month, some of the moths have not left till the beginning of October. As winter approaches, the stem seems to grow weak above the gall, and usually bends and droops, while the gall itself shrinks and acquires a whitish weather-washed appearance. It is for these reasons, and from the gall being so near the ground that it does not attract the same attention as the large, round gall of the *Trypeta*.

I have been acquainted with this gall for six years, and have studied it closely during that time. It seems to occur quite generally over the country, and is especially abundant in the West. The first published account that I can find of it in this country is that given by Baron Osten Sacken, in the first volume of the Proceedings of the "Philadelphia Entomological Society," page 369, where he correctly describes it, as well as the puffed carcass of one of the caterpillars (Pl. 2, Fig. 5), caused by a parasitic *Chalcis* fly presently to be described; but he was not acquainted with the maker of the gall. The galls were received by him from Edward Norton, who resides at Farmington, Connecticut. They occur abundantly around Chicago, especially on the north side, in the old cemetery, which is now being converted into Lincoln Park. They are equally abundant around St. Louis, while I have found the same gall on the *Solidaga Missouriensis* growing beyond Fort Kearney, in Nebraska, and even there the worm was attacked by the same parasitic *Chalcis* fly mentioned above.

The gall-making insects belonging to the same order (Lepidoptera) as our little moth, are by no means common, and the only other gall of this character with which I am acquainted, at all resembling the one just described, occurs on the stems of *Artemisia compestris* in France, and is produced by the larva of a very different little moth with pale yellow wings shaded with orange, first described by Herrich-Schæffer by the name of *Cochylis hilarana.* This last gall is figured on Plate 1, of the "Annales de la Société Entomologique de France" for 1856, and its history is detailed by M. E. Perris, at pages 33–38 of the same volume. The gall is similar in form, but narrower, with the walls thicker than that of my insect, while the larva is yellowish-white.

GELECHIA GALLÆSOLIDAGINIS, N. Sp.—*Larva.*—Length 0.60. Cylinderical. Color dark dull-brown, without shine. Largest on middle segments; tapering from 4th to head, and from 9th to extremity. Each segment impressed transversely in the middle, thus forming two folds, the thoracic segments having other such folds. Six small piliferous spots, two each side of dorsum and one above stigmata, which, together with the stigmata, are shiny and of a lighter brown than the body. Head and cervical shield light shiny-brown.

Chrysalis.—Length 0.50. Mahogany-brown. Form normal. Blunt at extremity.

Perfect moth.—Average length 0.38. Alar expanse ♀ 0 95, ♂ 0.75. Fore wings deep purplish-brown, more or less sprinkled with carneous. A light carneous band starts from the costa near the base, and curves towards the middle of the inner margin, which it occupies to a little beyond the beginning of the cilia, where it curves upwards towards the tip, reaching only half way up the wing. Here it is approached from above by a somewhat diffuse spot of the same color, which starts from the costa just behind the apex, and runs down to the middle of the wing.

In the plainly marked individuals there is an extra line running from the middle of the inner margin, outwardly obliquing to the middle of the wing, and then back to the inner margin a little beyond where the cilia commence, but in the great majority of specimens this mark is indistinct. Cilia light carneous. Hind wings slate-gray, with the cilia lighter. Antennæ finely annulated with the same two dark and light colors. Head, thorax and palpi light, with a sprinkling of the dark brown. Body dark, with light annulations, The species varies in the distinctness of its markings, and the light parts of the wing appear finely sprinkled with brown under the lens. Male generally smaller than female, with the antennæ proportionately a little longer.

Described from numerous bred specimens.

It seems to resemble *G. longifasciella* of Clemens, in coloration and pattern; but unfortunately our late lamented microlepidopterist, failed almost always to give the measurement of the species he described, and it is impossible to tell how much mine really resembles that species. Yet, as *longifasciella* was described from two mutilated specimens, received from A. S. Packard, jr., and as that gentleman has seen my insect and declared it an undescribed species, there can be little doubt of the fact.

Concealed within its gall, as this worm is, one would naturally suppose that it would rest unmolested from the outside world, and that no parasite could attack it through its green-walled fortress. Such however is not the case. Those oft-quoted lines, written in that spirit of ridicule, in the exercise of which Swift was always happy,

> "The little fleas that do so tease,
> Have smaller fleas that bite 'em,
> And these again have lesser fleas,
> And so *ad infinitum,*"

are as applicable to our gall-maker as to most other insects. There are indeed no less than six parasites which attack it, and from many hundreds of galls examined, I estimate that one worm out of every

five is thus destroyed. As four of these parasites are new to science, and are all probably confined to this one species of insect, I will briefly describe them.

They all belong to the order HYMENOPTERA, and by far the most common of them is a little fly of a dark metallic green color, with reddish legs, which is represented highly magnified in Plate 2, Figure 6, the hair line below showing the natural size. Its larvæ infest the caterpillar in great numbers, and cause it to swell to three and four times its normal size. After they have absorbed all the juices of their victim, they form for themselves very fine brownish coccons, which are so crammed together that they give the puffed-up worm the roughened appearance, shown at Plate 2, Figure 5, and prevent the skin from collapsing after they have left, so that it may be found within the gall at any time during the winter. These minute flies all leave the gall through a single minute hole, which must be made by one of their number. They are active little creatures, running nimbly, with their antennæ always bent towards the surface on which they travel. They have a wonderful power of jumping, and are able to leap the distance of a foot so suddenly and rapidly that they are, for the moment, scarcely visible. I have counted over 150 of them in a single caterpillar, and the mother fly must gnaw for herself a passage through the gall, and leisurely insert her batch of eggs in the inmate. This fly belongs to the *Chalcis* family, and may be called the Inflating *Chalcis* fly. The family to which it belongs has scarcely been at all studied in America, and very few species have been described. I therefore leave the species, for the present, undescribed, it apparently belonging to the genus *Pirene.*

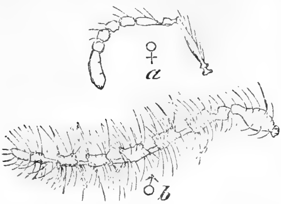
Another parasite which infests this caterpillar, is represented in the perfect state at Plate 2, Figure 9, the hair line above showing the natural size. It is a black fly, and its larva, which is often found at the bottom of the gall during the month of August, is a white, footless grub, about 0.24 long, and attenuated at the head. Some of these maggots change to pupæ and become flies in the fall of the year, while others remain in the maggot state till spring. The pupa is whitish, with the members confined and darker. This fly belongs to the same (*Chalcis*) family as the preceding, and to the genus *Eurytoma.* I name it in honor of my esteemed friend, Mr. A. Bolter, of Chicago—an entomologist, as enthusiastic as he is modest, and an indefatigable collector. When I think of the many happy hours we have spent together, and recall our many pleasant hunting grounds, the following pretty lines are ever floating in my mind:

> "I long to walk by the meadow's brook,
> To visit the fields and the woods once more,
> To loiter long in the shady nook,
> And tread the paths I have trod before;
> Or, under the spreading branches to lie
> And watch the clouds in the azure sky."

Annexed will be found a full description of this parasite:

EURYTOMA BOLTERI, N. Sp.—♀ Length 0.18. Antennæ black, not much longer than the face, perceptibly thicker towards the end, and apparently 10-jointed, though the three terminal joints are almost always confluent. Dimensions and appearance of joints, represented in the annexed Figure 97, *a*. Head and thorax rough-punctured and finely bearded with short, stiff gray hairs. Abdomen about as long as thorax, scarcely so broad, viewed from above, but wider viewed laterally; highly polished, smooth and black, the three terminal segments with minute stiff gray hairs along the sutures; visibly divided into seven segments, the four anterior ones of about equal length, the two following shorter, and the terminal one produced into a point. Legs fulvous with the *coxæ*, thighs and more or less of the shanks blackish-brown. Wings perfectly transparent, glossy, colorless, and with the nerves very faint.

[Fig. 97.]



♂ Measures but 0.14, and differs in the antennæ, being twice as long as the face, in their narrowing towards the tip and in being furnished with whorls of long hairs. The number of joints are not readily made out, and I have consequently presented at Figure 97, *b*, a magnified figure. His body is but half as wide and half as long as the thorax viewed from above, and not quite as broad as the thorax, viewed laterally; it also lacks the produced point of the ♀. His wings are also cut off more squarely and more distinctly nerved.

The third parasite which attacks our gall-maker is represented somewhat enlarged at Plate 2, Figure 7. It is an opaque black fly belonging to the true ICHNEUMON family and apparently to the genus *Hemiteles*. After most of the gall-makers have undergone all their transformations and escaped, some few of the galls are found still ininhabited by the worm. These belated worms contain the larva of this fly, and they are somewhat smaller and paler than are the healthy ones; their life as worms being prolonged by the presence of their enemy within. During the month of September, the parasitic larva leaves the body of the caterpillar, and spins for itself, within the gall, a tough white silken cocoon, in which it remains through the winter, and from which the fly escapes during the following March or April, some of them escaping much earlier than others. This fly I have named in honor of my friend Mr. E. T. Cresson, of Philadelphia, to whom I am indebted for the generic determination of all these parasites.

HEMITELES (?) CRESSONII.—♂—Length 0.25. Black, opaque, head transversely-subquadrate; face clothed with pale glittering pubescence; spot on mandibles, palpi, scape of antennæ in front and the tegulæ, white; eyes large, ovate; antennæ longer than head and thorax, slender, black; thorax closely and minutely punctured; mesothorax with a deeply impressed line on each side anteriorly; scutellum convex, closely punctured, deeply excavated at base; metathorax coarsely sculptured, truncate and excavated behind, the elevated lines sharply defined, forming an irregularly shaped central area, and a triangular one on each side of it, the outer posterior angle of which is prominent and subacute; wings hyaline, iridescent, nervures blackish, stigma large, areolet incomplete, the outer nervure wanting; legs pale honey-yellow, coxæ paler, tips of posterior femora, and their tibiæ and tasri entirely blackish; abdomen elongate ovate, flattened, petiolated, the first segment flat, gradually dilated posteriorly, somewhat shining, and indistinctly longitudinally aciculate; the two following segments opaque, indistinctly sculptured; remaining segments smooth and shining.

A fourth parasite, belonging to the same great ICHNEUMON family, issues from the worm and spins a white silken cocoon, in exactly the same manner as the preceding. From this cocoon at the same season of the year, escapes a fly which is also of very much the same size and appearance, but which belongs to the distinct genus *Microgaster*.

It has hitherto been undiscribed and may be known by the specific name of *gelechia*.

MICROGASTER GELECHIA—Length 0.20 ♂ ♀.—Black, clothed with a short, thin, glittering, whitish pubescence, most dense on the face, which latter is closely punctured; occiput and cheeks shining; mandibles rufopiceous; palpi whitish; eyes pubescent; antennæ as long as the body in ♂, shorter in ♀, 18-jointed; thorax shining, feebly punctured, mesothorax closely and more strongly punctured, with a deeply impressed longitudinal line on each side over base of wings; scutellum smooth and polished, the lateral groove broad, deep, arched and crenulated; metathorax opaque, densely rugose, with a sharp, central, longitudinal carina, and a smooth, flat, transverse carina at base; tegulæ testaceous, wings hyaline, iridescent, apex smoky, nervures blackish, areolet complete, subtriangular, radial nervure indistinct; legs pale honey-yellow, coxæ blackish, pale at tips, middle pair in ♀ concolorous with legs; abdomen with the two basal segments densely rugose and opaque, the remainder smooth and shining; venter more or less varied with pale testaceous.

The galls containing worms that have been victimized by either of these last two parasites are generally small and narrow, indicating that the worm has been sickly and not able to perform its functions in a proper manner, but those containing worms infested with the Inflating Chalcis-fly, first described, are of the normal size, the worm often having completed its passage-way before succumbing to its enemy.

There are two other and larger parasites which attack our little Gall-maker, the one an undescribed species of *Pimpla* and the other an undescribed species of *Ephialtes;* making in all six distinct parasites. Besides these, there is another insect which intrudes upon and often kills him. This last is the larva of some small long-horned beetle, and most likely of some species of the genus *Oberea*, as it greatly resembles the larva of *Oberea ocellata*, Hald., which I have bred from the stems of the Cottonwood. After the parent gall-moth has deposited her egg, and the young worm and its gall have acquired considerable size, the parent beetle of this larva comes along and deposits her egg higher up on the same stem, and the larva hatching from it immediately commences boring downwards till it reaches the gall, where it riots until it has crowded out the proper inhabitant and filled the gall with excrementitious and pithy *debris*. It then continues its descent till it reaches the root, where it continues boring till winter approaches, and where it hybernates in the larva state. Sometimes the gall-maker succeeds in webbing this intruder out, so that he only partially destroys the gall, while at other times the intruder does not reach the gall till the inmate has changed to the chrysalis state; but in the latter case the moth always dies in its endeavors to escape. The vacated galls of this gall-moth afford excellent winter shelter for a variety of insects and spiders, and the common Chinch bug is especially fond of taking up its winter quarters in them.

THE CHICKWEED GEOMETER, *Hæmatopis grataria*, Fabr.—Pl. 2, Figures 18, 19, 20 and 21.

(Lepidoptera Geometridæ.)

At Plate 2, Figure 18, I have figured a very common little moth which may be seen flitting over our meadows and in our gardens during the summer and fall months. It is of a delicate orange color, marked with pink, as in the figure. A number of persons have desired to know whether or not it was injurious, and what its larva fed on, and, as its transformations have been hitherto unknown, I will briefly record them.

The female moths deposit their eggs in rows of about twenty, along the edge of a leaf, or along the stem of the common chickweed (*Stellaria media.*) These eggs (see Pl. 2, Fig. 21) are not quite 0.02 of an nch long and are oval, flattened and depressed near the centre. When first laid they are yellowish-white, but change within two days to a very bright, shiny, red color, between Venetian and vermillion. These eggs hatch in a very short time, frequently within a week, into thread-like worms, with ten legs only and with the habit of looping themselves into all manner of shapes, especially into a circle. In about a month, during hot weather, they acquire their full size, when they are of the form and appearance of Plate 2, Figure 19. They are quite variable in color, being either gray, yellowish-green, or dark brown. They change to chrysalids within a slight web attached to the leaves of their food-plant, and in this state they bear the appearance of Plate 2, Figure 20, the skin being so thin that before the moth escapes the colors of the wings show distinctly through it. There are several broods during the year, and the insect may often be found in all its different states at one and the same time. It probably passes the winter in either the larva or egg state, for I have taken both eggs and half grown larvæ in the beginning of November. In the larva and chrysalis state it is not easily detected, on account of its small size and of its assimilating the color of the food-plant. The larva has furthermore the habit of jerking itself away to a considerable distance when disturbed, especially while it is young.

HÆMATOPIS GRATARIA, Fabr.—*Larva*—Average length 0.85. Color quite variable; either pale yellowish-green, deep rufous with an orange tint, or of a mixture of gray and cream-color. Minutely punctate all over. Segments 1, 2 and 3, extremely short; 4, longest and widest, having two wrinkles each side, with a dark depression between them; 5, 6, 7 and 8, of equal length; 9, 10 and 11, short, the two former also somewhat wider than the other. Dorsum dark, with a lighter middle line, and a light, somewhat irregular subdorsal line which converges anteriorly and diverges posteriorly of each segment; two dark spots anteriorly each side of the middle line. Sides more or less wrinkled, lighter than dorsum and with a light longitudinal ridge below. Venter variegated with longitudinal marks, and shaded outwardly with deep olive-green in strong contrast with the lateral light ridge. Stigmata minute, black, and placed on an oval swelling at the anterior portion of the segment. Head of the same color as body, with a dark line, edged each side with white, continuing from the thoracic segments.

Chrysalis.—(Plate 2, Fig. 20.) Length, 0.50. Wing sheaths and tip of abdomen pale buff, the middle of the abdomen very light yellowish-green. A purplish dorsal line. Obliquely truncated at the head, having a somewhat triangular appearance, the ventral angle being lengthened into a slightly bifurcate snout. Anal segments quite attenuated, the extremity being also slightly bifurcated. Stigmata small, black and distinct.

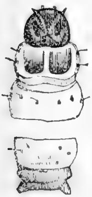
THE THISTLE PLUME,—*Pterophorus carduidactylus*, N. Sp., Pl. 2, Figs. 13 and 14.

(Lepidoptera Alucitidæ.)

Having already sketched the history of the Grape Plume, page 137, the larva of which attacks the Grape vine, I will now give the history of another species of the same *genus* whose larva infests the common Thistle (*Cersium lanceolata*) in order to show how very dissimilar two larvæ may be, which belong to the same genus and greatly resemble each other in the perfect state.

During the month of May the heads of the above named thistle may frequently be found drawn together by silken threads, with some of the leaves frequently dead. On pulling this webbed mass apart from eight to a dozen thick smooth worms may be found, which are of a light straw color with rows of black spots, and the head and tail marked as in the accompanying figure. These worms are found of different sizes in the same head, which would indicate that the parent moth either deposits her eggs at different intervals in the same place or that the eggs hatch out irregularly. Towards the end of May they change to pupæ within the burrow which the worm inhabited; these pupæ being of a dull yellow color, without polish, and resembling the pupæ of some long-legged Crane fly (*Tipula*) rather than a moth—see Pl. 2, Fig. 14. In just one week after they have thus changed, the moths escape. This moth, which is represented at Plate 2, Figure 13, is of a tawny yellow color, with a prominent triangular dark spot on the outer third of the front wing, running from the front edge. As it differs from all hitherto described North American species, it may appropriately be called the Thistle Plume.

[Fig. 98.]



PTEROPHORUS CARDUIDACTYLUS, N. Sp.—*Larva*.—Average length 0.60. Largest in the middle of body, tapering thence each way. Color light straw-yellow—greener when young. Somewhat darker, partly translucent, dorsal, subdorsal and stigmatal lines. Two lateral rows of black spots, the lower spots rather smaller and placed behind the upper ones. A third row above these, and others along the back, but so small that they are generally imperceptible with the naked eye, except on the thoracic segments, being especially distinct on segment 2. Head small, black, sometimes inclining to brown. Cervical shield black, divided longitudinally in the middle by a lighter line. Caudal plate also black. Segment 11, besides the spots above mentioned, has two transverse black marks, the posterior one the largest. Thoracic legs black, the others of the same color as the body.

Described from 12 specimens.

Pupa.—Average length 0.45. Of form of Plate 2, Figure 14. Soft, dull yellow, with a lateral dusky line, each side of dorsum, and another, less distinct each side of venter. Also dusky about the head and wing-sheaths.

Perfect insect.—Length 0.45; alar expanse 0.80. Front wings bifid, the cleft reaching not much more than ¼ of wing; tawny yellow, with a distinct dark brown triangular spot running from costa to the base of cleft—sometimes a little below it—its posterior margin with a slight concave curve. Three dusky, diffuse longitudinal spots, one placed on the basal third of the wing at costa and frequently reaching along the costa to the triangular spot; one near the interior margin, a little nearer to the base of wing than the last, and one on the outer third of the interior margin. Two light-colored transverse lines across the end of wing, one very near and parallel with posterior margin, the other bordering the triangular spot behind, and curving across the lower lobe towards posterior angle. The space between these two light lines usually darker than the ground-color. Fringes dark with a light margin. Hind wings trifid, the upper cleft reaching a little beyond the

middle, the lower one to the base of wing. Color ashy-brown, the lower lobe produced into a dark angular spot about their middle posteriorly. Antennæ, palpi, head, thorax, and body, tawny yellow; legs of the same color with the exception of the tarsi, which are almost white, with alternate dark brown spots, the spines being black, with dusky tips.

ERRATA.

Page 8, line 21, for "being" read "were."
Page 10, line 1, for "Figure 3, ♂" read "Figure 3, ♀."
Page 12, line 20, for "last" read "1866."
Page 12, line 3 from bottom, after "February," add "(1867)."
Page 31, line 15, for "37°" read "38°."
Page 47, line 16, for "far" read "for."
Page 114, line 1, after "insect" read "(*Strietrus frimbriatus*, Say)."
Page 120, line 30, after "Cottonwood" read "(*Pemphigus vagabundus*, Walsh)."
Page 133, line 24 from bottom, for "preceding insect" read "Grape curculio."
Page 134, line 3 from bottom, for "Part V" read "Part VI."
Page 142, under the heading, add "(Lepidoptera, Tortricidæ)."
Page 166, under the heading, add "(Lepidoptera, Tineidæ)."

INDEX.

SECOND ANNUAL REPORT

ON THE

Noxious,

BENEFICIAL AND OTHER

INSECTS,

OF THE

STATE OF MISSOURI,

MADE TO THE STATE BOARD OF AGRICULTURE, PURSUANT TO AN APPROPRIATION FOR THIS PURPOSE FROM THE LEGISLATURE OF THE STATE.

BY CHARLES V. RILEY,
STATE ENTOMOLOGIST.

JEFFERSON CITY:
Horace Wilcox, Public Printer.
1870.

PREFACE.

To the Members of the Missouri State Board of Agriculture:

GENTLEMEN:—I herewith submit, for publication, my Second Annual Report on the Noxious, Beneficial and other Insects of the State of Missouri.

For my First Report, I prepared two lithographic plates, a certain number of which were colored. Such plates, when well executed, are an adornment to any work, but they are expensive; and upon conferring with different members of the Board, it was thought best to furnish two such plates for one-half the edition, rather than one plate for the whole edition. The plan has not worked well, however, since many of those persons most interested in the Report, and for whom it is more especially designed, failed to get copies which had plates.

For this Second Report, therefore, I have confined the illustrations to wood. Most of these wood-cuts are executed in the best style of the art, but they cannot possibly show to good advantage on such paper as was used in last year's Report; and the pains taken in the preparation of these cuts, and in hiring the very best engravers the country affords, seems too much like waste of time and means, when their effect is so spoilt by poor ink and poorer paper. If it is in the power of the Board, by proper action, to secure a better quality of paper for this Report, I sincerely hope that such action will be taken; for a clear impression of an insect cut is often absolutely necessary, to enable the general reader to recognize, in the field, the living form of the particular species which it represents.

The cause of Economic Entomology lost one of its greatest champions, and the farmers and fruit-growers of the West, and especially of our sister State, Illinois, suffered an irreparable loss, in the sudden death, on November 18th, 1869, of Mr. Benj. D. Walsh, of Rock Island. At the time of his death, he was State Entomologist of Illinois, and my Associate in the Editorship of the *American Entomologist*, published at St Louis; and I hardly need say that this sad and unexpected fate of my friend has very much increased my own labors. When I add to this the fact that Mr. Walsh was prostrated for over three months last spring and summer, and that Mr. Wilcox, our State Printer, was ready for this Report at an earlier day than I had

anticipated; you will not be surprised to learn that several subjects which I had contemplated treating of, have been unavoidably deferred another year.

In order to make the sense of the text plain to every reader, and at the same time to insure scientific accuracy, I shall continue to conform to the rules laid down in the introduction to my First Report—namely, to print all descriptions of merely scientific interest in small type; to use as far as possible a common name for each insect, always adding the scientific appellation in *italics* and parenthesis, so that it can be skipped, if necessary, without interfering in the least with the sense of the sentence; and to give the Order and Family to which each insect belongs, in parenthesis under each heading.

The reader will also bear in mind that the dimensions given, are expressed in inches and the fractional parts of an inch, 0.25 thus implying a quarter of an inch; and that the sign ♂ is an abbreviation for the word male, the sign ♀ for female, and the sign ☿ for neuter.

My grateful acknowledgments are due to the Superintendents of the Missouri Pacific, South Pacific, Iron Mountain, Hannibal and St. Joseph, North Missouri, and Illinois Central Railroads for free passes over their respective routes.

All which is respectfully submitted by

CHARLES V. RILEY,
State Entomologist.

St. Louis, Mo., Dec. 2, 1869.

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NOXIOUS INSECTS.

REPORT OF THE COMMITTEE ON ENTOMOLOGY.

READ BEFORE THE MISSOURI STATE HORTICULTURAL SOCIETY, AT ITS ELEVENTH ANNUAL MEETING, BY C. V. RILEY, CHAIRMAN OF THE COMMITTEE.

In the preparation of my Annual Report, I have dwelt in detail on many insects that have attracted attention during the year, either by their injuries or benefits. In that Report numerous illustrations will be used to appeal to the eye of the reader, and as it will be published in the same volume with your transactions, I deem it superfluous at the present time to dwell on the natural history of any one insect. Permit me, therefore, to cursorily refer to a few of the prominent entomological events of the year, and afterwards to make a few generalizations, which it is hoped will prove of some little interest and value.

The year 1869 may be set down as one in which our crops, as a general thing, have suffered less than usual from insect depredations. At least such has been the case in Missouri, and, judging from extensive correspondence, the same statement would hold true of most of the northern and middle States of the Union.

True, the Army-worm (*Leucania unipuncta*, Haw.), and the Grain Plant-louse (*Aphis avenæ*, Fabr.), appeared in many parts of the State in sufficient force to do considerable damage, and these two insects may always be expected in a tolerably wet year that was preceded by a very dry one. But most insects, and especially those which afflict you as horticulturists, have behaved exceedingly well, though it is difficult to say whether we are to attribute this good behavior on their part, to the increased knowledge of their habits which has

been disseminated among those who have to deal with them, or to the more potent and unalterable workings of Nature.

The Chinch Bug, which in the dry summer of 1868, committed such ravages upon our grain crops in many portions of our State, and especially in the southwest, was scarcely heard of in 1869, after the copious rains which characterized the past summer commenced to shower down. The Apple Worm, or Codling Moth has been altogether less injurious than it was the year before, and in Adair, Buchanan, Cooper, Callaway, Cass, Lewis and Polk counties, especially, and probably all over the State, our orchards have been loaded with fair fruit. This result was predicted by the writer, and may be attributed principally to the scarcity of the insect, resulting from the partial failure of the apple crop in 1868; but in some part to the improved methods of fighting the foe. For, as in our civil strifes, we introduce improvements in the machinery which is to slay the opposing armies, so in this progressive age, we believe in introducing machinery to battle with our liliputian insect hosts, whenever it is available. And the experience of the past year proves, that to destroy this insect, old pieces of rumpled rag or carpet placed in the crotch of a tree, are to be preferred to the hay-bands wrapped around it, because it requires altogether less time to place the rags in their place than to fasten the hay-band; and the worms which spin up in them can be killed by wholesale, either by scalding the rags or by pressing them through the wringer of a washing machine.

Owing to the severe drouth of 1868, which was unfavorable to its successful transformations, that dreaded foe of the fruit-grower, the Plum Curculio, was scarce in the early part of the season, and our plum and peach trees set a fuller crop than they had done before for years; but the subsequent moist weather was favorable to the underground evolutions of this little pest, and the new brood appeared in great numbers about the end of June and beginning of July, when they did much damage to stone-fruit and some damage to pip-fruit by the gougings which they made for food. As stated in an essay read before the State meeting of our Illinois horticultural friends, I have discovered a little cannibal in the shape of a minute yellow species of *Thrips*, which destroys vast numbers of the "Little Turk's" eggs; and let us hope, that by attacking the Curculio in its most vulnerable point, this *Thrips* may in the course of a few years reduce the numbers of the Curculio, as the ladybirds have done with the Colorado Potato-bug, or as the minute mite (*Acarus mali*) is known to have done with the common Oyster-shell Bark-louse of the Apple. The eggs of the Apple-tree Plant-louse (*Aphis mali*) which last winter so thickly covered the twigs of the apple trees in many orchards, hatched and produced a prodigious number of lice as soon as the buds commenced to burst. In this immediate neighborhood they were soon swept away, however, by their cannibal insect foes, and by insectivorous birds, such as the warblers, etc.; but a physiological

fact connected with this insect has been developed this year by Dr. E. S. Hull, the able Illinois State Horticulturist, which is of such importance that I cannot pass it over even in this brief report. He has ascertained that we suffer from the injurious punctures of their little beaks long after the lice themselves have disappeared. In fact, he has proved to his own satisfaction that the so-called "scab" in apples, which prevailed to such an alarming extent last year, and rendered thousands and thousands of bushels valueless for market purposes, is actually caused by the punctures of these lice. I said that the doctor had proved this matter "to his own satisfaction," because I believe that caution requires that we should not consider it as an established fact until all objections to it can be dispelled. Personally I have made no observations on this matter, but the facts in the case all add weight to Dr. Hull's theory, if such it can be called. Hitherto the cause of the "scab" on apples has been involved in mystery. It was supposed to have a fungoid origin; yet an examination will show that the scabby appearance is not caused by any live fungus, but by arrested growth of the cells which have become corky and cicatrized. The importance of this discovery of Dr. Hull's, should it once be firmly established, cannot well be estimated; for when we have once ascertained the cause of a disease, it need scarcely exist any longer. By destroying the lice we shall prevent scabby apples, and experience teaches that they can be destroyed by a good syringing of tobacco-water. We may expect, in this immediate vicinity, an almost total exemption from "scab" next year, for the apple trees are remarkably free from the minute black bead-like eggs of the Plant-louse with which they were so thoroughly peppered a year ago.

The Tent Caterpillar (*Clisiocampa Americana*) was more abundant than usual in our orchards, and the Tent Caterpillar of the Forest (*Clisiocampa sylvatica*) also appeared in great numbers both on our orchard and forest trees.

A worm which I have called the Pickle Worm, (*Phacellura nitidalis*, Cram.) and which had never been publicly noticed before, appeared in immense numbers, and did great damage to our cucumbers and melons by boring into the fruit, but as this insect, with others, will be fully treated of in my forthcoming Report, I will pass on to a more general subject.

"The pebble in the streamlet scant,
May turn the course of many a river;
The dew-drop on the infant plant,
May warp the giant oak forever."

In no department of science does the old proverb "prevention is better than cure," apply with such force as in that of Economic Entomology. In my studies and observations I have often been struck with the fact that many of our very worst insect enemies have been introduced from abroad, and that if this subject of Economic Entomology had been better understood and appreciated fifty years ago,

and the proper measures had been taken to prevent the introduction of these pests, we should at present be free from the curse of the great majority of them. We have, indeed, plenty of Native American insects, which have become great pests to the cultivator of the soil, on account of the artificial state of things which he induces. In a state of Nature, a given species of plant, in its struggle for existence, is scattered promiscuously over a certain extent of country, and the particular insect or insects which feed upon that plant, have to search for it over a comparatively extensive surface, and their multiplication is consequently restricted. But the pursuit of horticulture, for instance—which may be succinctly defined as the assembling in tracts of greater or less extent, of one species of plant at the expense and exclusion of others—causes the particular insects which feed upon that plant, to multiply unduly, and we have to use that same intelligence in subduing these insects, which we employ in producing the artificial results which caused their increase. In the normal state of things insects never increase unduly; but, on the contrary, always act as Nature's most faithful servants, and accomplish a most important work in her economy. Yet, for reasons explained above, they naturally become our enemies, and we should suffer from the depredations of our indigenous species, even though no foreign ones had been imported. But we have altogether more than our share of these insect depredators, and so truly is this the case, that insects which attract universal attention, and are considered as very serious evils in Europe, would not be deemed worthy of notice in this country. There, if they lose one-fifth of a given crop, the whole community becomes alarmed; but here the cultivator sometimes considers himself fortunate if he secures the half of his crop from insect ravages, and each State loses annually from fifty to sixty million dollars from this cause alone, though but four States have as yet made any attempt to prevent this serious loss. In order to bring this fact home to you, and to show why we suffer more than do our foreign brethren, I will read a paper, which I have prepared for the *American Entomologist*, on

IMPORTED INSECTS AND NATIVE AMERICAN INSECTS.

If we examine into the history, as detailed in a recent number of our Magazine, (pp. 15–22) of the imported Currant Worm and the Native Currant Worm, we shall find a very curious state of things. These two insects both produce Sawflies, which are so closely allied to each other, that although they are referred to distinct genera by Entomologists, it may be doubted whether the genus (*Pristiphora*) under which the native species is classified be not a mere subgenus of that under which the imported species is classified. Reasoning *a priori*, therefore, we should expect to find a very great similarity in the destructive powers of these two worms, especially as each of them infests the leaves both of the Red Currant and of the Gooseberry. But

what are the actual facts? On the one hand we see a Native American species—which must have existed here from time immemorial, feeding on our wild Gooseberries and perhaps on our wild Red Currant, and which yet has troubled our tame Gooseberries and tame Red Currants so very slightly, that it cannot be proved with absolute certainty to have ever done so at all, except in Rock Island county, Ills., and in Scott county, Iowa.*

On the other hand we see a species, only introduced into this country, from Europe, some twelve years ago, which has already almost put a stop to the cultivation of the Gooseberry and Red Currant throughout a large part of the State of New York, the northern borders of Pennsylvania, and the whole of Canada West, and is slowly but surely extending itself in all directions from the point where it was originally imported. What can be the reason of such a wide difference in the noxious powers of two such closely allied insects, feeding on exactly the same plants, but one of them indigenous to America and the other imported into America from Europe? Nor is this the only case of the kind. We can point out at least three other such cases. The Imported Onion-fly (*Anthomyia ceparum*), is a terrible pest to the onion-grower in the East, though it has not yet made its way out West. On the other hand, the Native American Onion-fly (*Ortalis arcuata*, Walker), which is a closely allied species and has almost exactly the same habits, has only been heard of in one or two circumscribed localities in the West, and even there does comparatively but little damage. Again, the Imported Oyster-shell Bark-louse (*Aspidiotus conchiformis*) is a far worse foe to the Apple and certain other fruit trees than our indigenous Harris's Bark louse, (*Asp. Harrisii*), though each of them infests the same species. Finally, the imported Meal-worm beetle (*Tenebrio molitor*) swarms throughout the whole United States, and is a great pest; while the Native American species (*Tenebrio obscurus*), which has almost exactly the same habits, belongs to the same genus, and is of very nearly the same size, shape and color, is comparatively quite rare among us, and is scarcely known to our millers and flour-dealers.

On a careful and close examination, it will be found that almost all our worst insect foes have been imported among us from the

*In Volume 15 of the *Prairie Farmer*, page 504, a correspondent from Jefferson county, Iowa, states that as early as June 11th, in the year 1865, "a small green worm had taken the lion's share of his currants and gooseberries." This may possibly refer to the Native Currant Worm, which feeds upon gooseberry and currant leaves, but it more probably means the Gooseberry Fruit-worm (*Pempelia grossulariæ*, Packard,) which feeds upon the gooseberries and currants themselves, and which may be found figured and described in our First Missouri Report, page 140. What a vast fund of information is scientifically unavailable, simply because correspondents are so stingy with their pen, ink and paper. Again the editor of the *Farmers' Union*, published at Minneapolis, Minn., says in a recent number of that paper, that several gardens in that vicinity have been for the past few years infested with the Currant worm, and that last year they visited his own garden for the second time, having, the previous year, made sad havoc with the foliage before they were discovered. Now, as there are three perfectly distict worms which attack the leaves of currant bushes, and as the editor contents himself with referring to "THE Currant Worm," the information he imparts is perfectly valueless to the Entomologist, and the practical man may be led astray by the remedies suggested.

other side of the Atlantic. The Hessian Fly* was imported almost ninety years ago; the Wheat Midge about half as long ago; the Bee Moth at the beginning of the present century; the Codling Moth, the Cabbage Tinea, the Borer of the Red Currant, the Oyster-shell Bark-louse, the Grain Plant-louse, the Cabbage Plant-louse, the Currant Plant-louse, the Apple-tree Plant-louse, the Pear-tree Flea-louse, the Cheese-maggot, the common Meal-worm, the Grain Weevil, the House Fly, the Leaf-beetle of the Elm, the Cockroach, the Croton Bug, and the different Carpet, Clothes and Fur Moths, at periods which cannot be definitely fixed. Even within the last few years the Asparagus-beetle has become naturalized in New York and New Jersey, whence it will no doubt spread gradually westward through the whole United States, while the Rape Butterfly was introduced about a dozen years ago, and is rapidly spreading over some of the Eastern States. And only a year ago the larva of a certain Owlet-moth (*Hypogymna dispar*), which is a great pest in Europe, both to fruit-trees and forest-trees, was accidentally introduced by a Massachusetts entomologist into New England, where it is spreading with great rapidity. It is just the same thing with Plants as with Insects. We have looked carefully through Gray's *Manual of Botany*, and we find that—excluding from consideration all cryptogams, and all doubtful cases, and all cases where the same plant is supposed to be indigenous on both sides of the Atlantic—no less than TWO HUNDRED AND THIRTY-THREE distinct species of plants have been imported among us from the Old World, all of which have now run wild here, and many of which are the worst and most pernicious weeds that we have to contend against. In the United States *Agricultural Report* for 1865 (pp. 510–519) will be found a list of ninety-nine of the principal "Weeds of American Agriculture," by the late Dr. Wm. Darlington. Of this whole number no less than forty-three, or nearly one-half, are species that have been introduced among us from the Old World. Among these we may enumerate here, as the best known and the most pernicious, Butter-cups (two species), Shepherd's Purse, St. John's Wort, Cow-cockle, May-weed or Dog-fennel, Ox-eye Daisy, Common Thistle, Canada Thistle, Burdock, Plantain, Mullein, Toad-flax, Bind-weed, Jamestown (Jimson) weed, Lamb's Quarter, Smart-weed, Field Garlic, Fox-tail Grass and the notorious Cheat or Chess. And to these we may add the common Purslane, which, through some strange oversight, has been omitted in Dr. Darlington's catalogue.

It will be supposed, perhaps, since there are about as many voyages made from America to Europe as from Europe to America, that we have fully reciprocated to our transatlantic brethren the favors

*For the sake of the scientific reader, we subjoin here, in their regular order, the scientific names of the Insects catalogued by their English names in the text of this paragraph: *Cecidomyia destructor, Diplosis tritici, Galleria cereana, Carpocapsa pomonella, Plutella cruciferarum, Ægeria tipuliformis, Aspidiotus conchiformis, Aphis avenæ, A. brassicæ, A. ribis, A. mali, Psylla pyri, Piophila casei, Tenebrio molitor, Sitophilus granarius, Musca domestica, Galeruca calmariensis, Blatta orientalis, Ectobia germanica, Tinea tapetzella, vestianella, pellionella, &c.; Crioceris asparagi, Pieris rapæ and Hypogymna dispar.*

which they have conferred upon us, in the way of Noxious Insects and Noxious Weeds. It is no such thing. There are but very few American insects that have become naturalized in Europe, and even these do not appear for the most part to do any serious amount of damage there. For example, on one or two occasions single specimens of our Army-worm Moth (*Leucania unipuncta*) have been captured in England; but the insect has never spread and become ruinously common there, as it continually, in particular seasons, does in America. Our destructive Pea-bug (*Bruchus pisi*) has also found its way to Europe; but although it is met with in England, and according to Curtis has become naturalized in the warmer departments of France, Kirby and Spence expressly state that it does not occur in England "to any very injurious extent," and Curtis seems to doubt the fact of its being naturalized in England at all.* Again, the only species of White Ant that exists within the limits of the United States, (*Termes frontalis*), has been known for a long time to be a guest at the Plant-houses of Schönbrunn, in Germany; but is not recorded to have ever as yet spread into the surrounding country. As to our American Meal-worm (*Tenebrio obscurus*), Curtis states that it has been introduced into England along with American flour, and that it is sometimes abundant in London and the provinces;† but Kirby and Spence say not one word about it, and it seems to be confined to the English sea-ports and the places where American flour is stored, without spreading into the adjacent districts.

A very minute yellow ant, however, (*Myrmica molesta*), which is often very troublesome with us in houses, has, according to Frederick Smith, "become generally distributed and naturalized" in houses in England; and Kirby and Spence state more specifically, that "it has become a great pest in many houses in Brighton, London and Liverpool, in some cases to so great an extent as to cause the occupants to leave them."‡ As to our Chinch Bug, our Curculio, our Plum Gouger, our two principal Apple-tree Borers, our Canker-worm, our Apple-tree Tent-caterpillar, our Fall Web-worm, our Peach-tree Borer, and our other indigenous pests among the great Army of Bad Bugs, nobody ever yet found a single one of them alive and kicking on the other side of the Atlantic. And with regard to Plants, the only two American plants that we know to have become so firmly established in Europe as to be a nuisance there, are an American aquatic plant, the common Water-weed (*Anacharis canadensis*), which has choked up many of the canals in England, and our common Horse-weed, or Mare's tail as it is called in the West, (*Erigeron canadense*), which has spread from America nearly over the whole world.

Since then, it can be demonstrated by hard, dry facts, that American plants and insects do not become naturalized in the Old World

*Kirby & Spence *Introd.* Letter 6th; Curtis *Farm insects*, p. 358.

†*Farm insects*, p 334.

‡Smith in Stainton's *Entom. Annual* 1862, p. 70, and 1863 pp. 59–62; Kirby & Spence *Introd.*, Letter 8th.

with anything like the facility with which the plants and insects of the Old World are every day being naturalized in America, there must be some cause or other for this singular state of things. What is that cause? It is, as we believe, a simple fact which is pretty generally recognized now as true by modern naturalists, namely, that the plants and animals of America belong, as a general rule, to an old-fashioned creation, not so highly improved and developed as the more modernized creation which exists in Europe. In other words, although this is popularly known as the New World, it is in reality a much older world than that which we are accustomed to call the Old World. Consequently, our plants and animals can no more stand their ground against European competitors imported from abroad, than the Red Indian has been able to stand his ground against the White Caucasian Race. On the other hand, if by chance an American plant or an American animal finds its way into Europe, it can, as a general rule, no more stand its ground there against its European competitors, than a colony of Red Indians could stand their ground in England, even if you gave them a whole county of land and an ample supply of stock, tools, and provisions to begin with. For throughout Animated Nature, as has been conclusively shown by Charles Darwin, there is a continual struggle for existence, the stronger and more favorably organized species overpowering and starving out from time to time their less vigorous and less favorably organized competitors. Hence, it is as hopeless a task for a poor puny, old-fashioned American bug to contend against a strong energetic, highly-developed, European bug, as it would be for a fleet of old-fashioned wooden ships to fight against a fleet of our modern iron-clads.

Let not "Young America," however, be altogether discouraged and disgusted at hearing, that our Animal and Vegetable Creation is more old-fashioned than that of what is commonly known as the Old World. The oldest geological formations, in which the remains of Mammals occur, contain the remains of such mammals exclusively (*Marsupialea*) as bring forth their young only partially developed, and carry those young about with them in a pouch, till the day of complete development and physical "second birth" arrives. In America we have a single genus—the Opossums—that belongs to this antediluvian type. In the three ancient continents they have absolutely none at all. But if in this respect America is more old-fashioned than Europe, Australia is still more old-fashioned than America; for there almost all their mammals possess this remarkable peculiarity; so that if the American creation is somewhat old-fogyish, that of Australia is the very concentrated essence of old-fogyism itself. Consequently, if Europe crows over us as altogether "behind the times," "Young America" can take its revenge by crowing over Australia, as the land of the Kangaroo and the Wombat and other such exploded absurdities of the Mesozoic epoch.

The theory advanced in the above paper, may meet with some objectors, although I confidently believe in the inference there stated of the relative advancement and improvement of the flora and fauna of the two continents. But there is another reason why the insects which are imported into this country multiply at a prodigious rate, and soon acquire herculean power of doing harm, though they may never have stepped beyond the limits of propriety in their own native home—a reason too palpable and evident to savor of the theoretical. It is, that whenever an injurious insect is introduced in our midst, as a general rule the particular parasite or parasites which kept it in check abroad, are not introduced with it. In consequence, the foreigners, unaccompanied by the usual *gens d'armes*, throw off all restraint and play the deuce with our crops; just as the rats and mice will take possession of, and overrun a house, if not restrained by human or by feline agencies.

Sometimes, as in the case of the Imported Currant-worm, the noxious insects introduced from the old world are attacked by native American parasites, but as I believe the parasites of European nativity to be, as a rule, more energetic and vigorous than our indigenous ones, it would be advisable even in such a case, to import in addition such species as prey upon it in Europe. But in the case of the Wheat Midge which has actually flourished among us for almost half a century without a single parasite of any kind whatever infesting it from one end of the country to the other, it is sheer folly and cupable shiftlessness not to import among us from the other side of the Atlantic some one or all of the three different *Chalcis* flies which are known to check it throughout all Europe. And so with other insects which are known to be unaccompanied with the parasites which attack them abroad. Years and years ago Dr. Fitch demonstrated in print the policy of such a step; but bugs and bug-hunters are so very generally the subject of festive ridicule among the high and low vulgar, that hitherto the recommendation of the State Entomologist of New York has met with no practical response.

Now no one will fail to understand the force of the old proverb already quoted, after listening to these facts. Let us profit by the experience of the past, and while battling with those foes which are already in our midst, let us keep a watchful eye, and be on our guard ready to crush any new plague that may threaten us, before it gets beyond control. Yes, but say you, how is this to be accomplished? Can it be done by the government? Yes, in some cases; as for instance in the importation of parasites, government aid should be solicited. If, in 1860, when the Asparagus Beetle (*Crioceris asparagi*, Linn.) was first introduced on to Long Island, the Legislature of the State of New York had taken proper action in the matter, the insect might have been stamped out of the island at the trivial expense of a few hundred dollars, instead of being allowed to multiply, as it did, to such an extent as to occasion a dead loss of some fifty thousand

dollars in a single county, and of spreading from the island into the adjoining country. Quite recently a weevil (*Bruchus granarius*) which does immense damage to peas and beans and some other plants in Europe, was introduced into New York in some pods which a certain gentleman presented to the New York Farmers' Club, and if the proper steps are at once taken, it may yet be prevented from spreading through the country.

In Europe vast sums have been expended in founding professorships of Economic Entomology in the various agricultural colleges, and in conducting elaborate experiments on the best means of checking and controlling these tiny foes. But the entire sum expended by Congress or by our various State Legislatures for this purpose, from the Declaration of Independence to the year of our Lord 1869, cannot exceed ninety or one hundred thousand dollars, or about one thousand dollars a year. Yet the annual damage done by insects within the limits of the United States cannot be less than three hundred million dollars. Indeed, it is but quite recently that the people, from necessity, have awakened to the importance of the subject. We now have an Entomologist connected with the Department of Agriculture at Washington, and, with proper care, he can be of inestimable service to the country, in preventing the introduction of noxious insects. It is not noxious weeds alone, such as the Canada thistle, which are sent broadcast over the land by the distribution of uninspected seeds; but noxious insects are very frequently distributed in the same way. We have the highest authority, Dr. J. L. LeConte, of Philadelphia, for the statement, that before the Entomologist received his appointment, a noxious beetle, *Rhizopertha pusilla*, which has now become naturalized here, was originally introduced into this country in wheat from the Patent Office.

Therefore, there can be no doubt that much may be done at headquarters. That government aid cannot be of any avail in the great majority of instances, however, is equally apparent to those who have studied this question; and we must trust to a more thorough dissemination of such information as will enable each individual to protect himself. Much is being done in this direction by means of State Reports, through the *American Entomologist*, and through our various agricultural and horticultural journals; but much yet remains to be done. We must bear in mind that by enlightening our neighbors, we are helping ourselves, and, as horticulturists, we should urge that more attention be paid in our colleges, and especially in those of an Industrial nature, to the study of the Natural Sciences.

In my First Report, I have shown how the Oyster-shell Bark-louse, though perfectly able to live in the northern part of this State, is yet unknown there; and I tremble, lest some one in carelessness or ignorance should, introduce this dreaded plague of the apple grower into that section, from some Eastern or Northern nursery. Every

tree received from a distance should be examined from "top to stern," as the sailors say, before it is planted, and all insects, in whatever state they may be, destroyed. There can be do doubt that many of our worst insect foes may be guarded against by these precautions. The Canker-worm, the different Tussock-moths or Vaporer-moths, the Bark-lice of the Apple and of the Pine, and all other scale insects (*Coccidæ*), the Apple-tree Root-louse, etc., are continually being transported from one place to another, either in earth, on scions, or on the roots, branches, and leaves of young trees; and they are all possessed of such limited powers of locomotion, that unless transported in some such manner, they would scarcely spread a dozen miles in a century.

In the Pacific States, fruit-growing is a most profitable business, because they are yet free from many of the fruit insects which so increase our labors here. In the language of our late lamented Walsh, "although in California the Blest, the Chinese immigrants have already erected their joss houses, where they can worship Buddha without fear of interruption, yet no 'Little Turk' has imprinted the crescent symbol of Mahometanism upon the the Californian plums and the Californian peaches." But how long the Californians will retain this immunity, now that they have such direct communication with infested States, will depend very much on how soon they are warned of their danger. I suggest to our Pacific friends that they had better "take the bull by the horns," and endeavor to retain the vantage ground they now enjoy. I also sincerely hope that the day will soon come when there shall be a sufficient knowledge of this subject throughout the land, to enable the nation to guard against foreign insect plagues; the State against those of other States, and the individual against those of his neighbors.

THE CHINCH BUG—*Micropus leucopterus*, Say.

(Heteroptera, Lygæidæ.)

[Fig. 1.]

a

Few persons will need to be introduced to this unsavory little scamp, but, lest perchance, an occasional reader may not yet have a clear and correct idea of the meaning of the word Chinch Bug, I represent herewith (Fig. 1) a magnified view of the gentleman. The hair-line at the bottom shows the natural size of the little imp, and his colors are coal-black and snow-white. He belongs to the order of Half-winged Bugs (HETEROPTERA), the same order to which the well known Bed Bug belongs, and he exhales the same loathsome smell as does that bed-pest of the human race. He subsists by sucking, with his sharp-pointed

beak, the juices of our cereals, thereby causing them to shrink and wither, and not by gnawing or biting their substance, as many persons suppose. Insignificant as is the minute puncture of a single individual, yet these insects often appear in such countless numbers as to bleed to death whole fields of grain by their myriad beaks.

If the Western Fruit-grower is asked, what particular insect is the most difficult for him to combat, and the most destructive to his crops, he will probably answer "The Curculio." If the same question is put to the Western Grain-grower, he will infallibly reply "The Chinch Bug." And he will be in the right. The Wheat-midge—popularly known in the West as the "Weevil" or the "Red Weevil"—does a considerable amount of damage, in particular years and in particular localities, by its little legless orange-colored lava sucking away the sap from the growing kernel of wheat. The Hessian Fly—often called simply "the Fly"—injures the wheat by the maggot that produces it living between the stem and the sheath of the blade, and intercepting the sap before that sap can reach the ear. The Grain Plant-louse, easily distinguished from the above two little pests by its long sprawling legs, has in certain years somewhat injured the small grain in the West by accumulating, first on the growing stem and afterwards on the ear, and abstracting the sap with its long pointed beak. There are also, in all probability, several minute Two-winged Flies, which do more or less injury to the growing grain by their larvæ breeding in the stem, the natural history of one of which, the American Meromyza, was given for the first time in my First Report (pp. 159–61). The larva of an unknown moth, which burrows upwards and downwards in the stem of oats, and probably of wheat also, causing the ear to become prematurely white and the kernel to be entirely blasted, also in some years does considerable damage. The White Grub, the Wire-worm, and certain Cut-worms take a certain per centage of the young grain, almost as soon as it peeps out of the ground. But undoubtedly the meanest bug, out of the whole crowd of the multifarious insect-foes of the grain-growing farmer, is the Chinch Bug. He is not satisfied with taking a field here and a field there, and sparing the remainder. But when his time comes—and in mercy to the Western Farmer we are not cursed every year with this little savage—he sweeps the whole country with the besom of destruction. The Wheat-midge, the Hessian Fly, and the Grain Plant-louse, destructive as they are to small grain, yet spare our corn. If they take the good white wheaten bread out of our mouths, they yet leave us an ample supply of corn-dodgers. But the Chinch Bug makes a clean sweep, whenever he gets the upper hand of us. He "goes the entire hog." Nothing in the way of grain comes amiss to him. He is not dainty, not he! Whenever he gets a chance to spread himself, he first of all at one fell swoop destroys the small grain, and then fastens his liquorish beak upon the corn and takes that also.

PAST HISTORY OF THE CHINCH BUG.

The first record we have of the prevalence of the Chinch Bug was in the old Revolutionary times in North Carolina, where it was confounded with the Hessian Fly, an insect just then imported from Europe into the United States. Ever since those times it has been an epidemic pest, in particular years, in North and South Carolina and in Virginia. The great American entomologist, Thomas Say, in 1831, when he had been residing in Indiana for six years, was the first to name and describe it scientifically. He states that he "took a single specimen on the Eastern shore of Virginia;" whence we may reasonably infer that it was then either unknown or very rare in Indiana, and probably also in the other Western States. In Missouri it did considerable damage as early as 1854, for Jas. Pleasant of Fox Creek, St. Louis county, informed me that he had known it since that year, and that he had been previously acquainted with it in Virginia. Wm. M. Beal of Edina, Knox county, writes that it has existed and done more or less damage there since 1856, though it has scarcely been heard of since 1865. Mr. A. H. Roberts of Gray's Summit, Franklin county, informs me that it has not been in that neighborhood more than eight or ten years, and Mr. C. S. Jeffries, of Boles' post office in the same county, never heard of it till about fifteen years ago, though he has lived there for the last fifty years.

If proper records existed, we should doubtless find that it attracted attention in Missouri at a much earlier day, for in Illinois it was noticed as long back as 1840, in Hancock county, where it was absurdly supposed to have been introduced by the Mormons of Nauvoo, and was called the "Mormon louse"

In 1868, owing to the great drouth, this insect, as I have stated elsewhere, was quite injurious in many sections of our own State, and especially in the southwest. In the extreme northern portion they began to attract attention about the first of May, but the wet weather that occurred about that time caused them to disappear. In the more central counties the earliest sown wheat suffered but little from their depredations, though that which was sown later, was reduced about one-third. The conditions being favorable, they rapidly increased during the Summer, and in the fall, the second brood was so numerous that great fears were entertained for the safety of the crops of 1869. Let us be thankful, however, that the excessive rains of last spring and summer, though deplored and regretted by many, had the effect to so thoroughly drown out these little pests, as to make them comparatively harmless; for the only place in which I heard of their doing serious harm was at Tinney's Grove in Ray county. Seeming misfortune is often a blessing in disguise, and though the corn crop was lessened by the heavy rains, the wheat crop in all probability would have suffered far worse, had the season

been dry and favorable to the increase of this, the greatest insect foe of the wheat-grower.

We may safely conclude that the Chinch Bug has always existed in Missouri, in small numbers; but that it did not multiply to an injurious extent until the grains began to be cultivated on an extensive scale. At all events, we know from the evidence of Dr. Harris and Dr. Fitch, that it existed long ago in exceedingly small numbers in New York, and even in Massachusetts. What the causes may have been, that thinned out the numbers of this insect in former times in the West, is another question. In former times, the great bulk of these bugs were probably destroyed every winter by the prairie fires, and, as cultivation has extended in consequence of the country being gradually settled up, and less and less prairie has been annually burnt over, the number that has survived through the winter to start the next year's broods has annually become greater. If these views be correct, we may expect them, unless more pains be taken to counterwork and destroy them, to become, on the average of years, still more abundant than they now are, whenever prairie fires shall have become an obsolete institution; until at last Western farmers will be compelled, as those of North Carolina have already several times been compelled, to quit growing wheat altogether for a term of years.

It may be very reasonably asked, why the Chinch Bug does not increase and multiply in Massachusetts and New York, seeing that it existed there long ago, and that there are, of course, no prairie fires in those States to keep it in check. The answer is, that the Chinch Bug is a Southern, not a Northern species; and that hundreds of Southern species of insects, which on the Atlantic seaboard only occur in southerly latitudes, are found in profusion in quite a high latitude in the Valley of the Mississippi. The same law, as has been observed by Professor Baird, holds good both with Birds and with Fishes.*

NATURAL HISTORY OF THE CHINCH BUG.

In the four great and extensive Orders of Insects, namely, the Beetles (*Coleoptera*), the Clear-winged Flies (*Hymenoptera*), the Scaly-winged Flies (*Lepidoptera*), and the Two-winged Flies (*Diptera*), and in one of the four small Orders in its restricted sense, namely, the Net-winged Flies (*Neuroptera*), the insect usually lies still throughout the pupa state, and is always so far from being able to eat or to evacuate, that both mouth and anus are closed up by membrane. In the remaining three small Orders, on the contrary, namely, that of the Straight-winged Flies in its most extensive sense (*Orthoptera* including *Pseudo-neuroptera*), the Half-winged Bugs (*Heteroptera*) and the Whole-winged Bugs (*Homoptera*), the pupa is just as active and just as ravenous as either the larva or the perfect

* Silliman's Journal, xli, p. 87.

insect, and the little creature never quits eating as long as the warm weather lasts, except for a day or so while it is accomplishing each of its successive three, four or five moults. As the Chinch Bug belongs to the Half-winged Bugs, it therefore continues to take food, with a few short intermissions, from the day when it hatches out from the egg to the day of its unlamented death.

Most insects—irrespective of the Order to which they belong—require 12 months to go through the complete circle of their changes, from the day that the egg is laid to the day when the perfect insect perishes of old age and decrepitude. A few require 3 years, as for example the Round-headed Apple-tree Borer (*Saperda bivittata*, Say) and the White Grub which produces the May-beetle (*Lachnosterna quercina*, Knoch.) One species, the Thirteen-year Locust (*Cicada tredecim*, Riley), actually requires 13 years to pass from the egg to the winged state; and another, the Seventeen-year Locust (*Cicada septemdecim*, Linn.) the still longer period of 17 years. On the other hand there are not a few that pass through all their three states in a few months, or even in a few weeks; so that in one and the same year there may be 2, 3 or even 4 or 5 broods, one generated by the other and one succeeding another. For example, the Hessian Fly (*Cecidomyia destructor*, Say), the common Slug-worm of the Pear (*Selandria cerasi*, Peck), the Slug-worm of the Rose (*Selandria rosæ* Harris), the Apple-worm and a few others, produce exactly two generations in one year, and hence may be termed "two-brooded." Again, the Colorado Potato-beetle in Central Missouri is three-brooded, and not improbably in more southerly regions is four-brooded. Lastly, the common House-fly, the Cheese-fly, the various species of Blow-flies and Meat-flies, and the multifarious species of Plant-lice (*Aphis*) produce an indefinite number of successive broods in a single year, sometimes amounting in the case of the last-named genus, as has been proved by actual experiment, to as many as nine.

As long ago as March, 1866, I published the fact that the Chinch Bug is two-brooded in North Illinois (*Practical Entomologist*, I, p. 48), and I find that it is likewise two-brooded in this State. and most probably in all the Middle States. Yet it is quite agreeable to analogy that in the more Southern States, it may be three-brooded. For instance, the large Polyphemus Moth is single-brooded in the Northern and Middle States, and yet, two broods are sometimes produced in this State, while in the South it is habitually two-brooded. Again, the moth known as the Poplar Spinner, (*Clostera Americana*, Harris), is stated by Dr. Harris and Dr. Fitch to be only single-brooded in Massachusetts and New York, the insect spinning up in September or October, passing the winter in the pupa state, and coming out in the winged form in the following June. But Dr. Harris—no doubt on the authority of Abbott—states that "in Georgia this insect breeds twice a year;"* and I have proved that it does so breed in Missouri, having

Injurious Insects, p. 434.

now (Dec. '69) a number of cocoons which were formed by a second brood of larvæ. It is quite reasonable, therefore, to infer that the Chinch Bug may produce even more than two broods in the more Southern States.

It is these two peculiarities in the habits of the Chinch Bug, namely, first, its continuing to take food from the day of its birth to the day of its death, and secondly, its being either two-brooded or many-brooded, that renders it so destructive and so difficult to combat. Such as survive the autumn, when the plants on the sap of which they feed are mostly dried up so as to afford them little or no nourishment, pass the winter in the usual torpid state, and always in the perfect or winged form, under dead leaves, under sticks of wood, under flat stones, in moss, in bunches of old dead grass or weeds or straw, and often in corn-stalks and corn-shucks. In the fall and winter of 1868, I repeatedly received corn-stalks that were crowded with them, and it was difficult to find a stalk in any field that did not reveal some of them, upon stripping off the leaves. I have even found them wintering in the gall made by the Solidago Gall-moth (*Gelechia gallæsolidaginis*), described in the First Report.

In the winter all kinds of insect-devouring animals, such as birds, shrew-mice, etc., are hard put to it for food, and have to search every hole and corner for their appropriate prey. But no matter how closely they may thin out the Chinch Bugs, or how generally these insects may have been starved out by the autumnal droughts, there will always be a few left for seed next year. Suppose that there are only 2,000 Chinch Bugs remaining in the spring in a certain field, and that each female of the 2,000, as vegetation starts, raises a family of only 200, which is a low calculation. Then—allowing the sexes to be equal in number, whereas in reality the females are always far more numerous than the males—the first or spring brood will consist of 200,000, of which number 100,000 will be females. Here, if the species were single-brooded, the process would stop for the current year; and 200,000 Chinch Bugs in one field would be thought nothing of by the Western farmer. But the species is NOT single-brooded and the process does NOT stop here. Each successive brood increases in numbers in Geometrical Progression, unless there be something to check their increase; until the second brood amounts to twenty millions, and the third brood to two thousand millions. We may form some idea of the meaning of two thousand millions of Chinch Bugs, when it is stated that that number of them, placed in a straight line head and tail together, would just about reach from the surface of the earth to its central point—a distance of four thousand miles.

According to the reasoning of Dr. Henry Shimer, of Mr. Carroll, Illinois, who published an interesting paper on this insect in the proceedings of the Academy of Natural Science of Philadelphia for May, 1867, the Chinch Bug takes wing only at its love seasons, which occur in his locality in May and in August. His views on this subject are

well set forth in the following paragraph taken from the paper above alluded to:

May 16, 1865, was a delightful, mild, bright, sunny, summer-like day: and I again, for the last time, observed the same highly interesting phenomena, which I have noticed above as occurring after the harvest of 1864—the atmosphere swarming with Chinch Bugs on the wing. This is their spring; that was their autumnal nuptial season—their season of love. These remarkable little creatures prefer to conduct their courtships under the searching gaze of the noonday sun, instead of at the midnight hour. They were so numerous, alighting on the pavements in the village, that scarcely a step could be taken without crushing many of them under foot. In a few days, they had all disappeared; their breeding grounds were chosen, where they could be found in great numbers, often in pairs. I first noticed this disposition of the Chinch Bug to take wing under the promptings of the love passion, about six years ago, in their autumnal love season. At no other time save their love season, twice a year, have I ever seen one Chinch Bug flying. It is quite remarkable that the winged imago, under no other circumstances will even attempt to use its ample wings. No threatening danger, however imminent, whether of being driven over by grain reapers, wagons, or of being trodden under foot, etc., will prompt it to use its wings to escape. I have tried all imaginable ways to induce them to fly, as by threshing among them with bundles of rods or grass, by gathering them up and letting them fall from a height, etc., but they invariably refuse entirely to attempt to use their wings in escaping from danger. The love emotion alone makes them conscious that they are in possession of wings.

I agree entirely with Dr. Shimer as to the facts mentioned in the paragraph, but not as to the conclusions which he deduces. There are many objections to his theory, some of which may be found in the *American Entomologist*, (Vol. I, pp. 172–3).

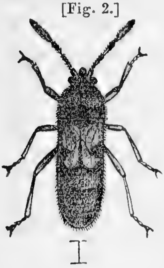
It is a notorious fact that Chinch Bugs do not all mature at once, and if they took wing only when making their courtships, some of them would be flying during a period of several weeks; and as will be shown presently, there exists a dimorphous short-winged form of the Chinch Bug, which cannot possibly make any such ærial love trips. It seems more agreeable to analogy that they take wing only when they have become so unduly numerous that they are instinctively aware that they must either emigrate or starve. Be this however as it may, the fact of their being as a general rule unwilling to use their wings is well known to every practical farmer.

It has long been known that the Chinch Bug deposits its eggs underground and upon the roots of the plants which it infests, and that the young larvæ remain underground for some considerable time after they hatch out, sucking the sap from the roots. If, in the spring of the year, you pull up a wheat plant in a field badly infested by this insect, you will find hundreds of the eggs attached to the roots; and at a somewhat later period the young larvæ may be found clustering upon the roots and looking like so many moving little red atoms. The egg is so small as to be scarcely visible to the naked eye, of an oval shape, about four times as long as wide, of a pale amber white

color when first laid, but subsequently assuming a reddish color from the young larva showing through the transparent shell.* As the mother Chinch Bug has to work her way underground in the spring of the year, in order to get at the roots upon which she proposes to lay her eggs, it becomes evident at once, that the looser the soil is at this time of the year the greater the facilities which are offered for the operation. Hence the great advantage of ploughing land for spring grain in the preceding autumn, or, if ploughed in the spring, rolling it repeatedly with a heavy roller after seeding. And hence the remark frequently made by farmers, that wheat harrowed in upon old corn-ground, without any ploughing at all, is far less infested by Chinch Bug than wheat put in upon land that has been ploughed. There is another fact which has been repeatedly noticed by practical men. This insect cannot live and thrive and multiply in land that is sopping with water; and it generally commences its operations in early spring upon those particular parts of every field where the soil is the loosest and the driest.

The female occupies about three weeks in depositing her eggs, and, according to Dr. Shimer's estimate, she deposits about 500. The egg requires about two weeks to hatch, and the bug becomes full grown and acquires its wings in from 40 to 50 days after hatching.

[Fig. 2.]



There are, as is well known to Entomologists, many genera of the Half-winged Bugs, which in Europe occur in two distinct or "dimorphous" forms, with no intermediate grades between the two; namely, a short-winged or sometimes even a completely wingless type and a long-winged type. Frequently the two occur promiscuously together, and are found promiscuously copulating so that they cannot possibly be distinct species. Sometimes the long-winged type occurs in particular seasons and especially in very hot seasons. More rarely the short-winged type occurs in a different locality from the long-winged type, and usually in that case in a more northerly locality. We have a good illustration of this latter peculiarity in the case of the Chinch Bug, for a dimorphous short-winged form (Fig. 2.) occurs in Canada, and Dr. Fitch describes it from specimens received from the States, as a variety, under the name of *apterus*.

DESTRUCTIVE POWERS OF THE CHINCH BUG.

Few persons in the more Northern States can form a just conception of the prodigious numbers and redoubtable armies in which this insect is sometimes seen in the South and Southwestern States,

* In Dr. Shimer's Paper the dimensions of the egg, as "determined with fine mathematical instruments," are said to be "0.04 inch long and 0.01 inch wide," (p. 99.) This is either a clerical or a typographical error for "0.004 inch long and 0.001 inch wide." Otherwise the egg would be nearly one-third as long as the insect itself; and as Dr. Shimer thinks that every female lays about 500 eggs, this would be something like getting a bushel of wheat out of a quart measure.

marching from one field to another. The following extracts—the first one written in June, 1865, by Dan. F. Rogers to the New York Farmers' Club, and the second from an old number of the *Prairie Farmer*—may seem a little far-fetched, but I have no doubt that both accounts are substantially correct:

There never was a better "show" for wheat and barley than we had here the 10th of June, and no more paltry crop has been harvested since we were a town. Many farmers did not get their seed. In passing by a field of barley where the Chinch Bugs had been at work for a week, I found them moving in solid column across the road to a corn field on the opposite side, in such numbers that I felt almost afraid to ride my horse among them. The road and fences were alive with them. Some teams were at work mending the road at this spot, and the bugs covered men, horses and scrapers till they were forced to quit work for the day. The bugs took ten acres of that corn, clean to the ground, before its hardening stalks—being too much for their tools—checked their progress. Another lot of them came from a wheat field adjoining my farm into a piece of corn, stopping now and then for a bite, but not long. Then they crossed a meadow 30 rods into a 16-acre lot of sorgo, and swept it like a fire, though the cane was then scarce in tassel. From wheat to sorgo was at least sixty rods. Their march was governed by no discoverable law, except that they were infernally hungry, and went where there was most to eat. *Helping a neighbor harvest* one of the few fortunate fields, early sown—and so lucky!—we found them moving across his premises in such numbers that they bid fair to drive out the family. House, crib, stable, well-curb, trees, garden fences—one *creeping* mass of stinking life. In the house as well as outside, like the lice of Egypt, they were everywhere; but in a single day they were gone.

If any Western rustics are verdant enough to suppose that Chinch Bugs cannot be out-flanked, headed off and conquered, they are entirely behind the times. The thing has been effectually done during the past season, by Mr. Davis, Supervisor of the town of Scott, Ogle county, Ills. This gentleman had a cornfield of a hundred acres, growing alongside of an extensive field of small grain. The bugs had finished up the latter and were preparing to attack the former, when the owner, being of an ingenious turn, hit upon a happy plan for circumventing them. He surrounding the corn with a barrier of pine boards set up edgewise, and partly buried in the ground, to keep them in position. Outside of this fence deep holes were dug, about ten feet apart. The upper edge of the board was kept constantly moist with a coat of coal tar, which was renewed every day.

The bugs, according to their regular tactics, advanced to the assault in solid columns, swarming by millions, and hiding the ground. They easily ascended the boards, but were unable to cross the belt of the coal tar. Sometimes they crowded upon one another so as to bridge over the barrier, but such places were immediately covered with a new coating. The invaders were in a worse quandary than that of Butler and Weitzel at Fort Fisher, and, in that state of mind crept backward and forward until they tumbled into the deep hole aforesaid. These were soon filled, and the swarming myriads were shoveled out of them literally by wagon loads, at the rate of thirty or forty bushels a day—and buried up in other holes, dug for the purpose, as required. This may seem incredible to persons unacquainted with this little pest, but no one who has seen the countless myriads which cover the earth as harvest approaches, will feel

inclined to dispute the statement. It is an unimpeachable fact. The process was repeated till only three or four bushels could be shovelled out of the holes, when it was abandoned. The corn was completely protected, and yielded bountifully.

HEAVY RAINS DESTRUCTIVE TO THE CHINCH BUG.

As the Chinch Bug, unlike most other true Bugs, deposits its eggs underground, and as the young larvæ live there for a considerable time, it must be manifest that heavy soaking rains will have a tendency to drown them out. The simple fact, long ago observed and recorded by practical men, such as Mr. B. E. Fleharty of North Prairie, Knox county, Ills., that this insect scrupulously avoids wet land, proves that moisture is naturally injurious to its constitution. Hence it was many years ago remarked by intelligent farmers, and we had an illustration of it the present year (1869), that very often when the spring opens dry, Chinch Bugs will begin to increase and multiply in an alarming manner; but that the very first heavy shower checks them up immediately, and repeated heavy rains put an almost entire stop to their operations. It is very true that nearly all insects will bear immersion under water for many hours, and frequently for a whole day, without suffering death therefrom; for although animation is apparently suspended in such cases, they yet, as the phase is, "come to life again." But no insect, except the few that are provided with gills like fishes and extract the air out of the water, instead of breathing it at first hand, can stand a prolonged immersion in water without drowning. And it must be obvious to the meanest capacity, that an insect, such as the Chinch Bug, whose natural home is the driest soil it can find, will have its health injuriously affected by a prolonged residence in a wet soil.

In fact the whole history of the Chinch Bug, from the very earliest records which we have of it, points unmistakably to the fact that a wet season affects it injuriously, and often almost annihilates it. arolina and Virginia, during the dry years which preceded 1840, it had become so numerous that the total destruction of the crops was threatened; but fortunately, unlike its predecessors, the summer 1840 was quite wet and the ravages of the bug were at once arrested. In Illinois and in this State it had increased to an alarming extent during the latter part of the late Rebellion; but the excessive wet summer of 1865 swept them away to such an extent that it was difficult to find any in the fall of that year. So it was again in 1869–70, and so it always has been, and doubtless always will be. It will be well therefore for farmers to bear in mind, that *in a hot, dry season Chinch Bugs are always the worst, and that in a wet season it is impossible for them to do any considerable amount of damage.*

Dr. Shimer, however, is not satisfied with this simple theory. He has gotten up and expounded to the world a new and recondite theory of his own, namely, that in the terrible wet season of 1865, when the Chinch Bug, although in early spring it had appeared in

very great numbers, was almost annihilated in the course of the summer, it perished, not as others had foolishly supposed, from the direct operation of the rain, but indirectly through a certain mysterious epidemic disease analogous to the Cholera or the Yellow Fever among human beings. He fully allows that the mortality among the Chinch Bugs was contemporaneous with the wet weather; but he will have it that it was not the wet weather that killed the Bug, as we common folks have always hitherto believed, but that it was his newly-discovered Epidemic Disease. But as in the conjoint article in the *American Entomologist* (I, pp. 174–6) this Epidemic theory was fully considered by my late associate, Mr. Walsh, in his own peculiar style, I shall not dwell upon it here.

CANNIBAL FOES OF THE CHINCH BUG.

As long ago as 1861, Mr. Walsh, in his *Essay upon the Injurious Insects of Illinois*, published facts which tended to show that four distinct species of Ladybirds preyed upon the Chinch Bug.* The first of these four is the Spotted Ladybird (*Hippodamia maculata*, DeGeer, Fig. 3), which also preys upon a great variety of other insects, attacking both the eggs of the Colorado Potato Bug and those of certain Bark-lice; and which is further remarkable for being one of the few insects found both in Europe and in North America.

[Fig. 3.]

[Fig. 4.]

In corroboration of the fact of its preying on the Chinch Bug, I may state, that the Rev. Chas. Peabody, of Sulphur Springs, informs me that he has repeatedly found it so feeding on his farm. The second species is the Trim Ladybird (*Coccinella munda*, Say, Fig. 4), which is distinguishable at once from a great variety of its brethren by having no black spots upon its red wing-cases. The other two are much smaller insects, belonging to a genus (*Scymnus*) of Ladybirds, most of the species of which are quite small and of obscure brown colors, and hard to be distinguished by the popular eye from other beetles, the structure of which is very different, and which therefore belong to very different groups and have very different habits.

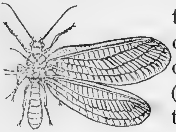
In the autumn of 1864 Dr. Shimer ascertained that the Spotted Ladybird which has been sketched above, preys extensively upon the Chinch Bug. In a particular field of corn, which had been sown thick for fodder, and which was swarming with Chinch Bugs, he found, as he says, that this Ladybird, "could be counted by hundreds upon every square yard of ground after shaking the corn; but the Chinch Bugs were so numerous that these hosts of enemies made very little perceptible impression among them."

In the same autumn Dr. Shimer made the additional discovery, that in the very same field of fodder-corn the Chinch Bugs were preyed upon by a very common species of Lacewing-fly, which he

*See *Trans. Ill. St. Agric. Society*, IV, pp. 346–9.

described in January, 1865,* as the Illinois Lacewing (*Chrysopa Illinoiensis*). The description was republished, together with the substance of Mr. Shimer's observations in the *Prairie Farmer*, of Chicago, Ill., accompanied with a non-characteristic wood-cut of the larva, cocoon and imago. At this time Mr. Shimer favored me with two specimens of the perfect insect, and he likewise furnished Mr. Walsh with additional specimens. From these specimens, it is evident that the species is the same as that described long before, by Dr. Fitch, as the Weeping Lacewing (*Chrysopa ploralunda*). In 1868, I found the same species quite numerous in a wheat field belonging to Mr. T. R. Allen, of Allenton, where its larvæ were perhaps feeding on the Chinch Bugs, as they were found to do in North Illinois, by Dr. Shimer.

[Fig. 5.]



The Lacewing flies all bear a striking resemblance to one another, both in size, shape and color; and to convey a correct idea of their appearance, it is only necessary to repeat the annexed drawing (Fig 5.) from my First Report, where a sketch of their natural history will be found (pp. 57–8).† They almost all of them, in the fly state, have a characteristic and disagreeable odor, resembling nothing so much as human ordure.

According to Dr. Shimer, the Weeping Lacewing-fly was not quite as abundant as the Spotted Ladybird among the fodder-corn, but still there were so many of them, that he thought that "there was one or more of them for every stalk of that thickly sown corn." "Every stroke of the cutter," he adds, "would raise three or four dozen of them, presenting quite an interesting spectacle as they staggered along in their awkward, unsteady flight." And he not only actually observed the larvæ preying very voraciously on the Chinch Bugs in the field, but he reared great numbers of them to the mature Fly by feeding them upon Chinch Bugs. His account of the operations of the larva when in captivity is so interesting that I quote it in full:

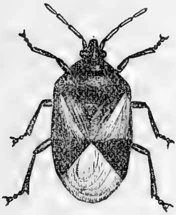
I placed one of the larvæ in a vial, after having captured it in the field in the very act of devouring Chinch Bugs of all sizes, and subsequently introduced into the vial a number of Chinch Bugs. They had hardly reached the bottom before it seized one of the largest ones, pierced it with its long jaws, held it almost motionless for about a minute while it was sucking the juices from the body of its victim, and then threw down the lifeless shell. In this way, I saw it destroy in quick succession, about a dozen bugs. Towards the last, as its appetite was becoming satiated, it spent five or more minutes in sucking the juices from the body of one bug. After this bountiful repast, it remained motionless for an hour or more, as if asleep. Never for

*Proc. Ent. Soc. Phil., IV, pp. 208–12.

†In that account I stated as a fact which, so far as I was aware, had not been recorded by any previous writer, that the insect issues from the small cocoon in an active sub-imago state, from which, after a few hours, the winged fly emerges, leaving behind it a fine silvery-white transparent skin. I have since found that Dr. Shimer, in the scientific paper already referred to, had previously recorded the very same fact.

a single moment, during the feast, did it pause in the work. When not in possession of a bug, it was on the search for, or in the pursuit of others. It manifested much eagerness in the pursuit of its prey, yet not with a lion-like boldness; for on several occasions I observed a manifest timorousness, a halting in the attack, as if conscious of danger in its hunting expeditions, although here there was none. Sometimes, when two or more bugs were approaching rapidly, it would shrink back from the attack, and turning aside go in the pursuit of others. At length, awakening, it would renew the assault as before. On one occasion, when it was on the side of the vial, two inches up, with a large bug in its mouth, I jarred the vial, so that it fell to the bottom and rolled over and over across the bottom, but holding on to its prey, it regained its footing and mounted up to its former position. Occasionally the Chinch Bugs would hasten to escape when pursued, as if in some degree conscious of danger.

Fig. 6.



I

The Insidious Flower Bug, (*Anthocoris insidiosus*, Say), of which I represent herewith a highly magnified figure, (Fig. 6), may often be found in company with the Chinch Bug, under the husks of ears of corn. It is quite common in Missouri, where I have found it in several different galls, and especially in the Grape-vine Leaf-gall, where it was preying on the lice (*Phylloxera vitifoliæ*), which are the architects of the gall. It has often been mistaken for the Chinch Bug, and was upon one occasion sent to Dr. Fitch, by one of his correspondents, for that veritable Bug. Yet it undoubtedly preys upon the Chinch Bug, as well as upon a variety of other plant-feeding insects, and it therefore becomes very necessary that the farmer should learn to recognize it and distinguish it from the true culprit. It is very true that, practically, it will be found almost impossible to separate the sheep from the goats, and spare the lives of the former while condemning to destruction the unsavory little carcasses of the latter. Still, it will be some comfort to the grain-grower, when at some future day he may discover his small grain or his corn to be alive with Chinch Bugs, to perceive the bright orange-colored larvæ of the Insidious Flower-Bug dodging about among the blood-red or blood-brown larvæ of his bitter foes, and sucking out their life-blood with ravenous avidity; or to discover the little slow-going larvæ of the *Scymnus* group of Ladybirds, with such dense and evenly-shorn masses of short milk-white cottony threads growing out of their entire bodies that they look like little animated flakes of cotton wool, crawling about among the stinking crowd and making many a hearty meal off them, stink they never so badly; or, finally, to watch the lizard-like black and yellow larvæ of the Spotted Ladybird, and the Trim Ladybird, with their short, robust jaws, or the greenish-brown larvæ of the Lacewing-fly, with their long slender sickle-shaped jaws, running rapidly about among the hosts of their enemies, and smiting them hip and thigh without any more mercy than the Amale-

kites of old experienced at the hands of avenging Israel. He will then know that, even if he is himself powerless to make head against a host of minute foes, as numerous as the sand on the seashore, and as destructive and irresistible as the waves of the great ocean itself, Providence has provided a check upon the unlimited increase of his enemies; and that a Power which is above us all and provides for us all, and which alloweth not even a sparrow to fall to the ground unless by His especial permission, has said to every vegetable-feeding insect, through the mouths of the various Cannibal and Parasitic species which He has appointed to do His work: "Thus far shalt thou go, and no farther; and here shall thy proud hosts be stayed."

The common Quail of the Middle and Western States (*Ortyx Virginiana*) otherwise known as the Partridge in the Northern States has long since been known as a most efficient destroyer of Chinch Bugs, and the fact was some time ago published by myself in the *Prairie Farmer*, and by others in various Agricultural Journals and Reports. We also have the corroborative testimony of Dr Shimer, who is a good ornithologist. In the winter time, when hard pushed for food, this bird must devour immense numbers of the little pests which winter in just such situations as are frequented by the Quail; and this bird should be protected from the gun of the sportsman in every State where the Chinch Bug is known to run riot.

AMOUNT OF DAMAGE DONE BY THE CHINCH BUG.

According to Dr. Shimer's estimate, which may be considered a reasonable one, in the year 1864 "three-fourths of the wheat and one-half of the corn crop were destroyed by the Chinch Bug throughout many extensive districts, comprising almost the entire Northwest." At the average annual rate of increase, according to the United States Census, in the State of Illinois, the wheat crop of 1864 ought to have been about thirty millions of bushels, and the corn-crop about one hundred and thirty-eight million bushels. Putting the cash value of wheat at $1.25 and that of corn at 50 cents, the cash value of the corn and wheat destroyed by this insignificant little bug, no bigger than a grain of rice, in one single State and in one single year, will therefore, according to the above figures, foot up to the astounding total of OVER SEVENTY-THREE MILLIONS OF DOLLARS! Put it as low as we choose, it is still a "big thing;" and it is unnecessary to argue a question any further, when facts and figures speak so plainly.

REMEDIES AGAINST THE CHINCH BUG.

It has long been noticed that the Chinch Bug commences its ravages in the spring from the edges of a piece of grain, or occasionally from one or more small patches, scattered at random in the more central portions of it, and usually drier than the rest of the field. From these particular parts it subsequently spreads by degrees over the whole field, multiplying as it goes and finally taking the entire crop unless checked up by seasonable rains. In newly-broken land,

where the fences are new and consequently no old stuff has had time to accumulate along them, the Chinch Bug is never heard of. These facts indicate that the mother insects must very generally pass the winter in the old dead stuff that usually gathers along fences. Hence, by way of precaution, it is advisable, whenever possible, to burn up such dead stuff in the winter or early in the spring, and particularly to rake together and burn up the old corn-stalks, instead of plowing them in, or allowing them, as is often done, to lie littering about on some piece of waste ground. It is true, agriculturally speaking, this is bad farming; but it is better to lose the manure contained in the corn-stalks than to have one's crop destroyed by insects. Whenever such small infected patches in a grain field are noticed early in the season, the rest of the field may often be saved by carting dry straw on to them and burning the straw on the spot, Chinch Bugs, green wheat and all; and this will be still easier to do when the bugs start along the edge of the field. If, as frequently happens, a piece of small grain is found about harvest-time to be so badly shrunken up by the bug as not to be worth cutting, the owner of it ought always to set fire to it and burn it up along with its ill-savored inhabitants. Thus, not only will the insect be prevented from migrating on to the adjacent corn-fields, but its future multiplication will be considerably checked.

A very simple, cheap and easy method of prevention was recommended in the *Prairie Farmer* of April 19th, 1862, by Mr. Wilson Phelps, of Crete, Illinois. It may very probably be effectual when the bugs are not too numerous, and certainly can do no harm:

With twelve bushels of spring wheat mix one bushel of winter rye, and sow in the usual manner. The rye not heading out, but spreading out close to the ground, the bugs will content themselves with eating it, until the wheat is too far advanced to be injured by them. There will, of course, be no danger of the winter rye mixing with the spring wheat.

When Chinch Bugs are likely to march, as they often do, after the fashion of Army-worms, from an infected to an uninfected field, Mr. H. J. Everest, of Stoughton, Dane county, Wisconsin, recommends the following plan, which is stated to have been tried by several persons and found to be perfectly effectual, and which is substantially the same as that referred to on page 23:

Take common fence-boards, six inches or less wide, and run them around the piece, set edgewise, and so that the bugs cannot get under them or between the joints, and then spread either pine or coal tar on the upper edge, and they will not cross it. The tar needs renewing till the edge gets saturated, so that it will keep wet and not dry in any more, and either kind of tar is effectual. Then dig holes close to the boards, about like a post-hole, once in four or five rods, and run a strip of tar from the top of the board to the bottom on the outside opposite the hole, and they will leave the board, and in trying to get around the tarred stripe will slide into the hole, where they will be obliged to remain till they can be buried at leisure, and new holes opened for more victims. It is seldom one has to fence more than

one side of a field, but wherever the fence is, it is a sure stop.—*Proc. New York Farmers' Club.*

Finally, when the Chinch Bugs are already in the field which it is proposed to rescue from their clutches, Mr. Michael Hopps, of Lyonsville, Cook county, Illinois, says that he saved a piece of wheat by sowing gas-lime broadcast over it, at the rate of six or seven bushels to the acre; and that the effect was that the bugs immediately left his field, and his crop was saved, while the wheat of his neighbors was nearly ruined by them. He further states that "a neighbor had a field of wheat adjoining his (Mr. Hopps's) cornfield, in which the bugs worked badly. Thinking that, as soon as the wheat was cut, they would emigrate to his corn, he dropped a handful of the gas-lime upon each hill of corn, in the same manner as plaster is often dropped upon corn in the East. The consequence was that the bugs did not attack the corn in the least."—(*Prairie Farmer.*)

But, if gas lime keeps off Chinch Bugs, which may or may not be the case, it appears that coal-tar most certainly will not do so, as the following experiment of Dr. Shimer's proves:

May 26th, 1864.—I saturated some saw-dust with coal-tar, and mixed some quick-lime among it, so that it might be in a good condition for handling, and sowed it thickly broadcast over a portion of my wheat field, where the bugs were very numerous.

May 27th–29th, 1864.—The bugs refuse to leave the part of the field where I sowed the tarred saw-dust, so there is but little hope of driving them from their once chosen grounds, by the seasonable application of strong smelling drugs.

I have known farmers to follow the plan of going through a wheat field badly infested with Chinch Bugs, and with a sickle to cut, here and there, small patches of the wheat which they threw on the ground in the form of a loose irregular shock. The bugs would gather under these cut stalks in great numbers from the standing grain, and could then be destroyed either by crushing or by burning them with straw.

The above remedies are selected as the most likely to prove practically successful, from a mass floating round in the various Agricultural Journals, some of them utterly absurd and irrational, and others of very doubtful use. As to the ridiculous proposal put forth in the Waukegan (Ills.) *Gazette*, in 1865, with a great flourish of trumpets, by one D. H. Sherman of that town; namely, to destroy the Chinch Bugs in the egg state by pickling all the seed wheat; it is sufficient to observe that this insect *never* deposits its eggs upon the kernel of the ripe wheat. Consequently, to attempt to kill Chinch Bug eggs, by doctoring the seed wheat, would be pretty much like trying to kill the nits in a boy's head by applying a piece of sticking-plaster to his great toe. In the old *Practical Entomologist* (I, p. 48), I showed that there were no such eggs in the wheat kernels, which Mr. Sherman himself had sent me, and which he had supposed to be thus infested.

BOGUS CHINCH BUGS.

Few things are more astonishing than the acuteness of perception superinduced by being constantly conversant with some one particular subject. I have often been surprised at the readiness with which nurserymen will distinguish between different varieties of Apple, even in the dead of the year, when there are no leaves, and of course no fruit on their nursery trees. In the same way old practiced shepherds can recognize every individual sheep out of a large flock, though, to the eyes of a common observer, all the sheep look alike. Experienced grain-growers, again, can distinguish at a glance between twenty different varieties of wheat, which the best botanist in the country would fail to tell one from the other; and I have been informed that a miller of many years' standing, as soon as he has shouldered a sack of wheat, knows at once whether it is spring grain or fall grain; while ninety-nine entomologists out of every hundred would probably be unable, on the most careful inspection, to tell the difference between the two, and some might even mistake wheat for rye.

It is not surprising, therefore, that persons who have paid no particular attention to the study of insects, often confound together insects which, in the eyes of the professed entomologist, look as different from each other as a horse does from a cow or a hog. It would, indeed, be little short of miraculous if this were not so; for there are about thirty thousand distinct species of insects to be found within the limits of the United States, and of course in such a vast multiplicity, there must be many strong resemblances.

I will therefore conclude this article on the Chinch Bug, by briefly mentioning several true Bugs, belonging to the same Order of Half-winged Bugs (*Heteroptera*), as that pestilent little foe of the farmer, and which I know to be frequently mistaken for it. The reader will then, by comparing the different figures, see at once how widely they all differ, and by a very little practice, his eyes will become so well educated that he will soon, without any artificial assistance from glasses, be able to distinguish the creatures one from the other, as they crawl or fly about in the almost microscopic dimensions assigned to them by their Great Creator.

One reason, perhaps, why so many different bugs are popularly confounded with the Chinch Bug, is the similarity of their smell. Everybody is aware that Chinch Bugs possess the same peculiarly unsavory odor as the common Bed Bug; and hence when a person finds a small insect that has this obnoxious smell, he is very apt to jump to the conclusion that it must be a Chinch Bug. No mode of reasoning, however, can be more unsafe or unsound. There are hundreds of different species of Half-winged Bugs—the common brown Squash Bug (*Coreus tristis*) for example—that possess this peculiar smell; and what is stranger still, although this smell is more usually

met with among the plant-feeders, there are a few of the true Cannibals that possess it to perfection. Among these I may mention the Spined Soldier-bug (*Arma spinosa*, Dallas) whose portrait I here reproduce from my First Report (Fig. 7 *b*); for, as the bitterest enemy of the Colorado Potato Bug, and consequently one of our best friends, he cannot too often be presented, or become too well known. We can well afford to endure his unpleasant odor, when we duly reflect on his kind services. Just think of it, you bitter bug-haters—this little soldier has, beyond all doubt, saved thousands of dollars to the State of Missouri in the last few years, by heroically stabbing and slaying countless hosts of one of your worst enemies! That he should have the bed-buggy odor is not very surprising, since he appertains to a large and extensive group, (the *Scutellera* family) most of the other species belonging to which are plant-feeders. Indeed it is a very general rule, to which I know of but one exception* that the insect in the great *Reduvius* family among the Half-winged Bugs, every one of which is of carnivorous propensities, never have this peculiarly nauseous aroma; and that it is bestowed only upon certain plant-feeding bugs, to protect them no doubt from their insect foes, in the same manner as the skunk is protected from the eagle by his odoriferous tail. Yet while many of the plant-feeding Bugs do have this odor, a good many of them are entirely free from it, and some few of them really smell so agreeably that the fact has been thought worthy to be recorded by entomological writers. Even that detestable pest, already referred to, the common Squash Bug, sometimes emits a pleasant aroma, altogether different from that which it normally gives out; for I have kept this winter, in a separate box, one which emits a most pungent but agreeable smell, very much resembling that of a very ripe, rich pear. But perhaps the most suggestive fact of all is that, notwithstanding the close alliance between the two Orders of Half-winged and Whole-winged Bugs, there is not a single known species of the latter that has ever been known to exhale the bedbuggy effluvium, which is met with in so many species belonging to the former.

[Fig. 7.]

a b

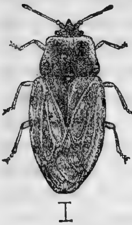
THE INSIDIOUS FLOWER-BUG.—First among the insects frequently mistaken for the Chinch Bug, may be mentioned the Insidious Flower-bug (*Anthocoris insidious*, Say) already referred to under the head of "Cannibal Foes of the Chinch Bug." This little Flower-bug has been usually referred by entomologists to the same extensive group (*Lygæus* family) as the true Chinch Bug, though more recent authors have placed it in a distinct group on account of its short three-jointed beak.

THE ASH-GRAY LEAF-BUG.—Second among the Bogus Chinch Bugs may be mentioned the Ash-gray Leaf-bug (*Piesma cinerea*, Say) a

* A shiny black species of *Nabis* (*Nabis marginatus*, Uhler, MS) smells as much like a Bed Bug as the most peaceable Plant-feeder.

small greenish-gray bug of which I present herewith a highly magnified figure (Fig. 8), its true size being about the same as that of the Chinch Bug for which it has been mistaken, though it lacks altogether the conspicuous black and white markings which characterize that

[Fig. 8.]

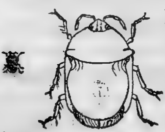


little grain pest, and really resembles it in nothing but the unpleasant odor which it emits. In the summer of 1868, Col. F. Hecker, of St. Clair county, Illinois (See *Am. Entomologist*, I, p. 19), found an insect, which he mistook for the Chinch Bug, destroying the blossom buds of his grape-vines. Now as the Ash-gray Leaf-bug is known to work in this way on the Grape-vine, and as I found it abundant in Col. Foster's vineyard, on the Iron Mountain Railroad in this State, it was doubtless this species which injured Col. Hecker's vines; for the true Chinch Bug has never hitherto been observed to attack woody plants like the Grape-vine, but confines itself exclusively to herbaceous plants, such as wheat, oats, Indian corn, etc. The Ash-gray Leaf-bug belongs to an entirely different group from the Chinch Bug (*Tingis* family) all the species of which have a short 3-jointed beak, which however differs from that of the 3-jointed beak of the Flower-bugs (*Anthocoris*) by being encased in a groove when not in use. They mostly live on green leaves in all their three stages, after the fashion of plant lice. Like the Chinch Bug, the Ash-gray Leaf-bug hybernates in the perfect state, and may be found in the winter in considerable numbers under the loose bark of standing trees and especially under that of the Shag-bark Hickory.

With the exception of the Ash-gray Leaf-bug, there is no North American species belonging to the genus, that is known to attack fruit trees or fruit-bearing bushes or vines; though there are several that infest forest trees—each species generally confining itself to a particular genus of trees. But in Europe there is a species, the Pear-tree Leaf-bug (*Tingis pyri*) which is so injurious to the Pear, that the French gardeners have given it the name of "the Tiger." It is to be hoped that it may never, like another European pest of pear-growers, the Pear-tree Flea-louse (*Psylla pyri*)—which has already been introduced into the New England States, and will perhaps make its way out West—traverse the Atlantic ocean and take out its naturalization papers in this country.

The Flea-like Negro-bug.—Third among the bogus Chinch Bugs may be mentioned the Flea-like Negro-bug (*Corimelæna pulicaria*,

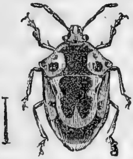
[Fig. 9.]



Germar), of which I here present a magnified outline (Fig. 9). Its color is black with a white stripe each side. This insect resembles the Chinch Bug in having an ordinary 4-jointed beak, but differs from it in belonging to a very distinct and well marked group (*Scutellera* family), which is characterized by the enormous size of the "scutel" or shield.

In the most numerously represented division of this family the scutel forms a large triangle, extending along the back about half-way to the tip of the abdomen, as may be seen in the figure of the Spined Soldier-bug (Fig. 7), referred to on a previous page. But in another division of this family which does not contain nearly so many species, the scutel, instead of being angular, is rounded at top and covers more or less the entire upper surface of the abdomen. It is to this last division that the Flea-like Negro-bug belongs, and the dirty yellow or white stripes at its sides are really nothing but the thickened anterior edge of the front wings, all the remaining part of the front wings, as well as the entire hind wings, being, in repose, completely hidden under this enormously extended shield. In the Bordered Soldier-bug, as the reader will perceive from the annexed drawing (Fig. 10), which I reproduce from my First Report, the scutel is indeed rounded, and also extends a considerable distance over the abdomen; but as it otherwise agrees with the other Soldier-bugs in the rest of its organization, it is classified with them, and not with our Negro-bug.

[Fig. 10.]



The Flea-like Negro-bug has been known to injure various plants for two or three years back. I found it exceedingly abundant last summer in all parts of the State which I visited. It has a great passion for the fruit of the Raspberry, and is sometimes so plentiful as to render the berries perfectly unsaleable by the bed-bug aroma which it communicates to them, as well as by sucking out their juices. Wherever it occurs, the nauseous flavor which it imparts to every berry which it touches, will soon make its presence manifest, though the little scamp may elude ocular detection. It is really too bad that such a little black varmint should so mar the exceeding pleasure which a lover of this delicious fruit always experiences when in the midst of a raspberry plantation in the fruit season. It is also quite injurious to the Strawberry, puncturing the stem with its little beak, and thus causing either blossom or fruit to wilt; and the following extract, taken from a communication to the *Western Rural* by Mr. B. Pullen, of Centralia, Ills., undoubtedly refers to the same Bug, and would indicate that it made its first appearance in that neighborhood last summer:

"A new insect, to us here, has appeared on our strawberries for the first time the past season, damaging the crop very much. It resembles somewhat the Chinch Bug, so destructive to our wheat and corn, and, judging from the peculiar odor they emit on being mashed, should think them very nearly related. Some claim that they are of a different species altogether. Whether this be so or not those interested in the cultivation of the strawberry are anxiously looking forward to another season to see if they are to continue their depredations."

It likewise attacks the Strawberry in Canada, as an account of its attacking that plant, is given by my friend, C. J. S. Bethune, in the

Canada Farmer for August 1st, 1867; and it was under this very same serious charge that it was apprehended and brought up for trial at the last May meeting of the Alton (Ills.) Horticultural Society. It also attacks both Cherry and Quince, occurring on these trees in very large numbers, and puncturing the blossoms and leaves, but especially the fruit stems, which in consequence shrivel and die. It is also quite injurious to garden flowers and especially to the Coreopsis, and abounds on certain weeds, among which may be mentioned the Red-root or New Jersey Tea-plant (*Ceanothus Americanus*), and Neckweed or Purslane-speedwell (*Veronica peregrina*). In the month of June under these two last named plants, they may be found in countless numbers of all sizes and ages, from the small light brown wingless, newly hatched individuals, to the full fledged jet black ones. In fact they breed on these weeds, and there is no more effectual method of checking their increase and thus preventing their injuries to our cultivated fruits, than by sprinkling these weeds, and the ground underneath them, with a good strong solution of Cresylic soap. I should advise the propagation of a small patch of either one of these weeds near a strawberry patch, as a decoy for the Bugs, which may thus be, to some extent, enticed away from the strawberry plants, and killed more readily.

There are two other species of Negro-bug which are common in this State, though they never swarm in such injurious profusion as does the Flea-like Negro-bug. The first of these (*Corimelæna lateralis*, Fabr.) is absolutely undistinguishable from it however, except in being fully one-half longer and wider. The shape, sculpturing and coloring are exactly the same, even down to the lateral white stripe; so that, but for the fact of no intermediate grades in size occurring, the two would be certainly considered as mere varieties of one and the same species. The other Negro-bug (*Cor. unicolor*, Beauv.) is fully twice as long and wide as our insect; but though resembling it closely in every other respect, yet differs very notably in lacking the white anterior edging to the front wings. It might indeed be said, that the biggest Negro dresses entirely in black, while the two other smaller sized darkies relieve the sombre monotony of their sable suits, by wearing a conspicuously white shirt-collar.

To these three bogus Chinch Bugs, might be added one or two other species of small stinking Bugs which have been, by some persons, mistaken for the true Chinch Bug. But enough has been already said to show, that insects which in reality are shaped and fashioned as differently as are cows and deer, are yet often confounded together in the popular eye, principally, no doubt, because they have the same peculiar bed-bug aroma. Should the ignorance of the popular judgment in confounding these tiny creatures which seem to the Entomologist so very, very different from each other, therefore, be despised and ridiculed? Far be it from me to display such intolerant stupidity! As well might the nurseryman ridicule the grain-grower,

because the grain-grower cannot distinguish a Baldwin Seedling from a High top apple; or the grain-grower the nurseryman because the nurseryman cannot tell Mediterranean from Tea wheat, or Club from Fife. I do, however, entertain an abiding hope that by the present very general and praiseworthy movement towards the popularization of Natural History, and by the dissemination of Entomological Reports, a better knowledge of this practically important subject will soon exist in the community. Our farmers will then, not so often wage a war of extermination against their best friends, the cannibal and parasitic insects, while they overlook and neglect the very plant-feeders which are doing all the damage, and upon which the others are feeding in the very manner in which a Wise Providence has appointed them to adopt.

RECAPITULATION.

The following important points in the history of the Chinch Bug, may be considered as firmly established:

1st. Chinch Bugs hybernate in the perfect or winged state in any old dry rubbish, under dead leaves, in old straw, in corn-shucks and corn-stalks, among weeds in fence-corners, etc., etc. Therefore all such substances should be burned up,as far as possible, inthe spring.

2nd. The earlier small grain can be sowed in the spring, the more likely it is to escape the Chinch Bug; for it will then get ripe before the spring brood of bugs has had time to become fully developed at the expense of the grain.

3d. The harder the ground is where the grain is sowed, the less chance there is for the Chinch Bug to penetrate to the roots of the grain and lay its eggs thereon. Hence the importance of fall-ploughing and using the roller upon land that is loose and friable. And hence, if old corn-ground is sufficiently clean, it is a good plan to harrow in a crop of small grain upon it without ploughing it at all. Moreover this rolling plan should always be adopted, as the best wheat-growers both in this country and in Europe attest that the heavier the ground for wheat is rolled, the better will be the crop.

4th. A single heavy rain immediately checks up the propagation of the Chinch Bugs. Continued heavy rains diminish their numbers most materially. A long-continued wet season, such as that of 1865, almost sweeps the whole brood of them from off the face of the earth; but from the rapid rate at which they multiply there will always be enough left for seed for another year. It may be laid down, not only as a general, but universal rule, that this insect is never ruinously destructive, except in those sections of country where there is continued hot dry weather; and that if, in two adjoining districts, there has been a dry summer in one and much wet weather during the summer season in the other, however plentiful and destructive the bug may be in the first district, it will scarcely be heard of in the second. Certainly this state of facts is not exactly that from which any reasonable man would infer, that the paucity of Chinch Bugs in a wet

season is caused by an Epidemic Disease taking them off. We might as well maintain that, although there was no Epidemic Disease among the children of Israel that had just crossed the Red Sea, or among the Egyptians that staid at home, it was simply and solely an Epidemic Disease that slew the pursuing hosts of the Egyptians and covered the bottom of the Red Sea with their carcasses.

THE ARMY-WORM—*Leucania unipuncta*, Haw.

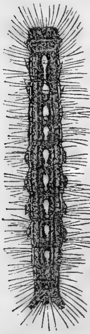
[Lepidoptera Noctuidæ.]

Among those insects which attract especial attention, either from the peculiarity of their habits, or the vast amount of damage which they inflict, the notorious Army-worm holds a conspicuous place. The mode in which these worms travel in vast armies when in search of food, the great value of the cereals and the grasses to which they for the most part confine their ravages, their sudden appearance in such incomputable numbers, and their equally sudden disappearance, all tend to arouse the curiosity and interest of even the most indifferent observer.

Before giving a history of this insect, it will be necessary to state that there are four distinct caterpillars, producing four perfectly distinct moths, which have been designated as Army-worms in various parts of the United States.

First—The Tent-caterpillar of the Forest (*Clisiocampa sylvatica*, Harr.) has been erroneously known by the name of "Army-worm" in the northwest corner of the State of New York. A back view of this caterpillar is given in the accompanying sketch (Fig. 11)

[Fig. 11.]



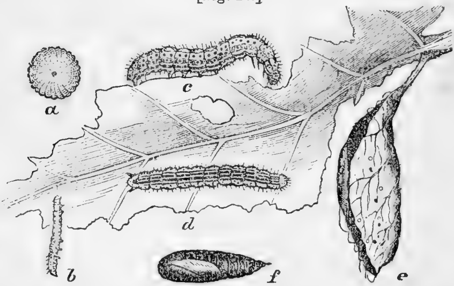
by which it will at once be recognized by the reader. For a number of days, last June, this worm might have been seen marching "single file" up the railroad track on Pilot Knob, in the scorching rays of the noonday sun; and it is often found crawling along roads in very considerable numbers. Yet it cannot with propriety be called an Army-worm, and our Eastern friends had best drop the title and avoid confusion in the future.

Second—The Cotton-worm (*Anomis xylina*, Say), is very generally known by the name of "the Cotton Army-worm," in the South. The term as applied to this species is not altogether inappropriate, as the worm frequently appears in immense armies, and when moved by necessity will travel over the ground in "solid phalanx;" and so long as the word "Cotton" is attached—its ravages being strictly confined to this plant—there is no danger of its being confounded with the true Army-worm. The term has furthermore received the sanction of custom in the Southern States, and of Mr. Glover in his Department Reports.

As various attempts have been made, with more or less success, to grow the cotton plant in the southern parts of this State, a description of this insect will not be inappropriate, the more especially, since it will teach the reader the difference between it and the true Army-worm.

The Cotton-worm was first scientifically described by Mr. Thomas Say, in the year 1827. According to Dr. D. L. Phares, of Woodville, Miss., it destroyed at a low estimate, 200 tons of cotton in the Bahamas as long ago as 1788; while in Georgia it completely destroyed the crop in 1793. According to Dr. Capers* its injuries were noticed in 1800, and it likewise proved very destructive in 1804, 1825 and 1826. Since the last date, as we may learn from old volumes of the *American Farmer*, of Baltimore, Md., and from the Patent Office Reports, it has done more or less damage to the crop almost annually, in some part or other of the cotton-growing district. As with the real grass-feeding Army-worm of the Middle States, it swarms in particular years to such an extent as to utterly ruin the crop, while in other years it is scarcely noticed. This fact has led many to infer that there is a stated periodicity in its returns in such immense numbers; but the natural history of the worm confutes such an idea, while the records give no foundation for the inference. The sudden increase or decrease of this, as of other species of noxious insects, depends on climatic, as well as on other equally potent influences.

[Fig. 12.]



The egg, (Fig. 12, *a*), according to Dr. Phares is shaped "precisely like a scull-cap, with rows of pinheads from base to apex as thickly set as possible," appearing as if moulded in a very deep saucer. These eggs are of a translucent green color, and are deposited upon the under side of the leaves, and from their small size, are naturally difficult of detection. Each female moth deposits from 400 to 600, and according to the late Thomas Affleck, of Brenham, Texas, they hatch two days after being deposited, if the weather be moist and warm. The worms (Fig. 12 *b*, $\frac{1}{3}$ grown) at first feed upon the parenchyma or soft fleshy parts of the leaves, but afterwards devour in-

*Patent Office Rep., 1855, p. 74.

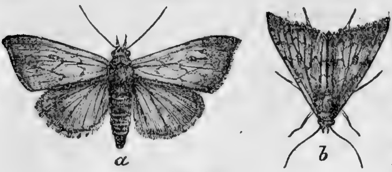
differently, not only any portion of the leaves, but also the blossom-bud and blossom, together with the calyx leaves at the base of the boll, thus causing the lobes which hold the cotton, to fall entirely back and allow the cotton to drop at the slightest touch. While young these worms readily let themselves down by a web when disturbed, but when older they make less use of this web, and jerk themselves away to a considerable distance when suddenly touched. They cast their skins at five successive periods, and come to their growth in the incredibly short space of fifteen or twenty days. Mr. Affleck even states that they usually enter the chrysalis state on the eleventh day after hatching; but I incline to believe that such a brief larval existence is extremely exceptional, and the length of time required for them to mature will not only differ in different individuals of the same brood, but will vary with the state of the atmosphere. At Figure 12 *c* is given a side view, and at *d* a back view of a full-grown worm. It has the normal complement of legs—namely 16—but the two foremost pair of false legs, or those under segments 6 and 7, are so reduced in size that they are scarcely used in motion, and it consequently loops when walking.

I have upon two occasions received full-grown specimens of this worm, and they differ materially, both in depth of shade, coloration and markings, as indeed do almost all the larvæ of moths belonging to the same (*Noctua*) family. The most common color is light green, though they are frequently quite dark with a purplish hue at the sides, and with black backs. Whether light or dark colored, however, they are more or less distinctly marked with pale longitudinal lines and black spots, as in the above figures.

Mr. Lyman, in his "Cotton Culture," says of this insect: "The first moths that visit a crop deposit their eggs and die. These eggs in ten days become little worms, which fall to eating the leaf on which they were hatched, and as they grow, consume the plant and pass to another. But age comes on apace with these ephemeral creatures; the worm presently grows weary of devouring, selects a leaf, rolls himself in a little cocoon and *dies*." Of course this is a serious mistake to think that the worm dies, else how could it produce the moth which, as Mr. Lyman himself shows, afterwards issues from the cocoon. It is astonishing to find such gross errors creeping into our popular works, but then, the study of these contemptible little Bugs, even if they do sometimes totally destroy the crop, is of course beneath the dignity of the man who can write a work on cotton culture!! The truth of the matter is that, when they have completed their growth, the worms fold over the edge of a leaf (Fig. 12 *e*), and, after lining the inside with silk, change to chrysalids (Fig. 12 *f*), which are at first green, but soon acquire a chestnut-brown color; after remaining in this last state (in which, though the insect is inactive, it is yet full of life, and undergoing wonderful development) from seven to fourteen days, or even longer, the moth escapes, the chrysalis being held fast

within the cocoon by means of several very minute hooks with which the tail is furnished.

[Fig. 13.]



At Figure 13 *a*, this moth is represented with the wings expanded, and at *b*, with the wings closed. The general color of the upper surface is a golden-yellow inclining to buff, with a faint olive tint near the outer or posterior margin. The fore wings are crossed, as in the above figures, by more or less distinct, irregular lilac-colored lines. But the chief characteristic is a dark slate-colored, or black spot on the front wings, in which spot there are paler scales forming almost a double pupil as represented in the figures, while between this spot and the base of the wings there is a much smaller pure white dot. In general color and in the position of the larger spot, this moth bears a remarkable resemblance to that of the true Army-worm of the Northern and Middle States.

Mr. Affleck, who certainly had abundant opportunities for observing the fact, assured me that this moth rests in the position shown in Figure 13, *b*, namely, with the head downwards. He wrote on August 22d, 1868: "The Cotton moth (*Ophinsa xylina* of Harris in his correspondence with myself) never alights in any other position, or if by accident it first assumes another position, it instantly wheels around *head down.*"

According to the best authority, there are three different broods of worms during the year, the first appearing in June or July, and the last, which does the most damage, appearing in August or September, or even later. Mr. Lyman, in the little work already referred to, says: "That nature has made no provision by which either the fly, the worm, the chrysalis or the eggs, can survive the winter or exist for any length of time where the cotton plant is not a perennial." But this is surely an error, which Mr. Lyman would never have made, had he possessed a better knowledge of insect-life; and as Mr. Glover found that the chrysalis was killed by the slightest frost, the insect evidently winters over in the moth state, as do many others belonging to the same tribe. Mr. W. B. Seabrook gives strong evidence that this is the case, in a "Memoir on the Cotton Plant," read in 1843, before the State Agricultural Society of South Carolina, wherein he says: "That the Cotton Moth survives the winter is nearly certain. An examination of the neighboring woods, especially after a mild winter, has often been successfully made for that purpose." And Dr. Phares states positively that the moth hybernates in piles of cotton seed under shelter, under bark and in crevices of trees in dense forests and other secluded places, and that it may often be seen on pleasant days in winter.

The two principal remedies which have hitherto been relied upon are, 1st, hand-picking; 2d, destroying the moths by fires, to which they are naturally attracted. The first method is sure, but tedious and somewhat impracticable on a very large scale. The second is most effectual if carried out when the first moths appear, in May and June. If these two methods were persistently carried out in the early part of the season throughout any given cotton-growing county, they would of themselves be sufficient to save the crop; but the efforts of individuals are of no avail, where there are slovenly neighbors who neglect to perform these labors. It would therefore be of incalculable advantage, if something could be applied to the plants which would prevent the moths from depositing their eggs upon them, as the industrious planter could then set at defiance his more slovenly neighbor. Mr. Affleck was enthusiastic in his praise of cresylic soap as such a plant-protector, and I received a long letter, written a few weeks previous to his death, and showing how he had found that no cotton moth had ever deposited an egg on any plant that had been sprinkled with a solution of this soap. But Dr. Phares states that it was pretty thoroughly tried last year, and proved a failure, though he does not give the reason why.

It is some little consolation to know that the character of the season determines their numbers, and that if none make their appearance in any stage by the first of July, there is little to be feared from them the rest of that year.

Third—There is in the South another insect (*Laphrygma frugiperda*, Sm. & Abb.?) which is frequently known by the ominous name of "Army worm;" an insect which also will attack cotton, though it prefers grasses and weeds. This species in its habits resembles the true Army-worm of the Middle States, more closely perhaps than does the Cotton Army-worm, and Mr. Joseph B. Lyman, in his recent work on "Cotton culture"* (p. 92), calls it *the* "Army-worm;" yet to prevent confusion, the cognomen should be discontinued, and the term "Southern Grass-worm" (by which it is already very generally known) should be strictly applied to this third bogus Army-worm. We now come to the veritable Army-worm of the Northern and Middle States —the insect which is the subject of this article, and we will dwell for a few moments on the

PAST HISTORY OF THE TRUE ARMY-WORM.

If we trace back the history of the Army-worm in this country, we find that inaccuracy and confusion characterize most of the records concerning it previous to the year 1861. In that year, however, by the contemporaneous observations and experiments of several entomologists, in different sections of the United States, its natural history was first made known to the world, and the parent moth identified.

* Cotton Culture, by J. B. Lyman, late of Louisiana. Orange Judd & Co., New York.

The very earliest record which we find of its appearance in this country is in Flint's 2nd Report on the Agriculture of Massachusetts, where it is stated that in 1743 "there were millions of devouring worms in armies, threatening to cut off every green thing."

In 1770 it spread over New England in alarming numbers. Dr. Fitch in his 6th Report quotes the following full and interesting account from the Rev. Grant Powers's Historical Sketches of the Coös Country in the Northern part of New Hampshire. "In the summer of 1770 an army of worms extended from Lancaster, the shire town of Coös County, N. H,, to Northfield, Mass., almost the whole length of the Granite State. They began to appear the latter part of July, and continued their ravages until September. They were then called the 'Northern Army,' as they seemed to advance from the north or northwest to the south. It was not known that they passed the highlands between the rivers Connecticut and Merrimack. Dr. Burton, of Thetford, Vermont, informed the author that he had seen the pastures so covered with them, that he could not put down his finger without touching a worm, remarking that 'he had seen more than ten bushels in a heap.' They were unlike anything that generation had ever seen. There was a stripe upon the back like black velvet, and on each side a stripe of yellow from end to end, and the rest of the body was brown. They were seen not larger than a pin, but in maturity were as long as a man's finger and of proportionate thickness. They appeared to be in great haste, except when they halted to feed. They entered the houses of the people and came up into the kneading troughs as did the frogs in Egypt. They went up the sides of the houses and over them in such compact columns that nothing of the boards or shingles could be seen. Pumpkin-vines, peas, potatoes and flax escaped their ravages. But wheat and corn disappeared before them as by magic. Fields of corn in the Haverhill and Newbury meadows, so thick that a man could hardly be seen a rod distant, were in ten days entirely defoliated by the 'Northern Army.' Trenches were dug around fields a foot deep, as a defence, but they were soon filled and the millions in the rear passed on and took possession of the interdicted feed. Another expedient was resorted to: Trenches were cut, and thin sticks, six inches in diameter, were sharpened and used to make holes in the bottom of the trenches within two or three feet of one another, to the depth of two or three feet in the bottom lands, and when these holes were filled with worms, the stick was plunged into the holes, thus destroying the vermin. In this way some corn was saved. About the first of September the worms suddenly disappeared. Where or how they terminated their career is unknown, for not the carcass of a worm was seen. Had it not been for pumpkins, which were exceedingly abundant, and potatoes, the people would have greatly suffered for food. As it was, great privation was felt on account of the loss of grass and grain."

The same writer adds that "in 1781, eleven years after, the same kind of worm appeared again, and the fears of the people were greatly excited, but this time they were few in number."

In 1790 their ravages are again recorded in Connecticut, where they were very destructive to the grass and corn, but their existence was short, all dying in a few weeks (Webster on Pestilence, I, 272.)

Their next appearance in the Eastern States was in 1817, after an interval of twenty-seven years, according to Fitch, who quotes the following paragraph from the Albany (N. Y.) *Argus:*

Worcester, *Mass.*, *May* 22*nd*, 1817.—"We learn that the black worm is making great ravages on some farms in this town, and in many other places in this part of the country. Their march is a 'displayed column,' and their progress is as distinctly marked as the course of a fire which has overrun the herbage in a dry pasture. Not a blade of grass is left standing in their rear. From the appearance of the worm it is supposed to be the same which usually infests gardens, and is commonly called the *cut worm.* * * * This same worm is also destroying the vegetation in the northern towns of Rensselaer and eastern section of Saratoga, New York. Many meadows and pastures have been rendered by their depredations as barren as a heath. It appears to be the same species of worm that has created so much alarm in Worcester county, but we suspect it is different from the cut worm, whose ravages appear to be confined to corn."

It was not until after a lapse of forty-four years from the last mentioned date, namely, in the summer of 1861, that this worm again spread over the meadows and grain fields of the Eastern States. During the interval, however, it had from time to time attracted attention in the Western States, where it often proved quite destructive. Thus, in Illinois, it is recorded as having appeared in 1818, 1820, 1825, 1826, 1834, 1841, 1842, 1845 and 1856, and according to Mr. B. F. Wiley, of Makanda, Ill., it was quite numerous and destructive in the southern part of the State in 1849, and appeared there also in 1857, though it was confined that year to limited localities.* Mr. J. Kirkpatrick, of Ohio, mentions its appearance in the northern part of that State in 1855. He says: "Last season (1855), in consequence of the heavy rains in the early part of June, the flats of the Cuyahoga, near Cleveland, were flooded. After the subsidence of the water, and while the grass was yet coated with the muddy deposit, myriads of small blackish caterpillars appeared; almost every blade had its inhabitant; no animal could feed upon it without, at every bite, swallowing several; if a new blade sprung up, it was immediately devoured, but what was most remarkable, the insects did not attempt to remove to land a foot or two higher but that had not been covered by the water."†

**Prairie Farmer,* July 18th, 1861.

†Ohio Agricultural Report, 1855, p. 350.

The year 1861 will long be remembered as a remarkable Army-worm year, for this insect was observed in particular localities throughout the whole northern and middle portion of the United States from New England to Kansas. It was first noticed in numbers sufficient to cause alarm, in Tennessee and Kentucky during the month of April; and toward the close of the same month it appeared in the southern counties of Illinois. By the end of June it had visited nearly all portions of the latter State, proving more or less destructive to grass, wheat, oats, rye, sorghum and corn.

Its advent in Missouri was simultaneous with that in Illinois, and judging from what facts I have accumulated, it occurred very generally over this State, though recorded only in St. Louis, Jefferson, Warren, Boone, Howard and Pike counties. No mention is made of its occurrence, at this time, in any of the States or Territories west of Missouri, but to the East, scarcely a single State escaped its ravages. In many portions of Ohio it entirely destroyed the hay and grain crops, and in the eastern part of Massachusetts the damage done was reported to exceed a half million of dollars.

Singularly enough, I can find no trace of the occurrence of this insect in Missouri prior to the year 1861, and the first intelligible account of it from the pen of a Missourian, is that by Dr. Wislizenus of St. Louis, published in the Transactions of the St. Louis Academy of Science (Vol. II, No. 1, pp. 159–60). My good friend Wislizenus then erroneously supposed it to be identical with the *Bombyx graminis* of Northern Europe—an insect which commits similar devastations on the grasses and cereals in that country. But I believe he is now well aware that it is an entirely distinct species.

Since 1861 the Army-worm has never spread so generally over such a vast extent of country, though in 1865 it appeared in considerable numbers around St. Joseph in this State, and in 1866 did some damage near Quincy, Ills., as we learn from the Quincy *Whig*.

Last year it made its appearance again in vast numbers in many portions of this State, especially in St. Louis, Jefferson, Cooper, Callaway, Henry, St. Clair, Marion, Ralls, and Lafayette counties, and in some counties in Illinois and Indiana. The first intimation I received of its appearance in Missouri was the following letter sent to me by Mr. A. E. Trabue of Hannibal, under date of June 8th:

I inclose a match-box with grass and two worms, which we think are Army-worms. They are here in myriads destroying the grass. Destroyed a hundred acres of blue grass meadow in five days, and are now advancing on me. What are they and their habits?

Carbolic acid (one part acid, 20 parts water) kills them if they get a good drench with it, but is too expensive at that rate. They will cross a trail of it without injury, though they evidently dislike the smell. Have sent to town for coal tar to see if they will cross it when the ground is soaked with it. The advancing column is a half mile wide.

The hogs are very fond of them; will not notice corn when they

can get Army-worms, but we have more of the latter than they can dispose of.

A. E. TRABUE.

Upon receipt of this letter, I visited Hannibal and ascertained that the worm was even more numerous around New London, and especially on the farm of Mr. A. McPike.

ITS SUDDEN APPEARANCE AND DISAPPEARANCE.

The popular idea about the sudden appearance of an insect has always been an erroneous one. The 'blows" or "gentiles" in meat, "skippers" and mites in cheese, plant-lice on plants, etc., etc., are very generally supposed to have a spontaneous origin, and our sudden Army-worm invasions have very generally been accounted for in the same way, by those who know nothing of Nature's workings. Yes, and so-called *savans*—will it be credited !—have been anxious to so far tickle the popular fancy as to conceive and give birth to theories (such as that of larval reproduction) which were not one whit more sensible or tenable.

It is well known to entomologists, and the reader, by perusing the article on "Cut-worms" in my First Report, will soon become aware of the fact, that most of the larvæ of our Owlet Moths (family *Noctuidæ*) rest hidden during the day and feed in the morning and evening, or at night. They are all smooth, tender-skinned worms, and cannot endure the scorching rays of the sun. Consequently many of them live almost habitually, just under the surface of the soil, while others shelter themselves under vegetable substances during the day. Our Army-worm forms no exception to the rule, for upon closely watching the habits of the hosts I witnessed last summer in the field, and of hundreds which I had confined in breeding cages, I ascertained that they frequently hide themselves Cut-worm fashion, just under the surface of the ground, or under the plants upon which they feed. The Army-worm delights, in fact, in cool, moist and shady situations, and from the passage already quoted, from Mr. Kirkpatrick, where it is shown that the worms which swarmed on the Cuyahogo flats, did not attempt to remove to land a foot or so higher: and from further facts recorded by Dr. Fitch, it becomes evident that its natural abode is in the wild grass of our swamps, or on low lands. During an excessive dry summer these swampy places dry out, and the insect, having a wider range where the conditions for its successful development are favorable, becomes greatly multiplied. The eggs are consequently deposited over a greater area of territory, and if the succeeding year prove wet and favorable to the growth of the worms we shall have the abnormal condition of their appearing on our higher and drier lands, and of their marching from one field to another. For just so soon as the green grass is devoured, in any particular field in which they may have hatched, these worms are forced, both from hunger and from their sensibility to the sun's rays, to leave the denuded field.

Thus the fact becomes at once significant and explicable, that almost all great Army-worm years have been unusually wet, with the preceding year unusually dry, as Dr. Fitch has proved by record. The appearance of this insect last summer in the West forms no exception, for the summer of 1868 was unusually dry and hot, while that of 1869 was decidedly wet. I may remark here, in further corroboration of these views, that, as might have been expected, no Army-worms were noticed last year in the Eastern States; for though in the summer of 1868 we of the West suffered so severely from drouth, yet in the East they were blessed with the usual amount of rain-fall, and in some sections had even more than the average amount.

There is in reality nothing in the least mysterious in the sudden appearance and disappearance of the Army-worm, for the truth of the matter is, that there are a few of these insects in some part or other of the country every year, and I have for the past four or five years captured one or more specimens of the moth every fall. The eggs hatch during the early part of May, in the latitude of South Illinois and South Missouri, and the young worms may feed by millions in a meadow without attracting attention; but when they have become nearly full grown and have stripped bare the fields in which they were born, and commence to march as described above, they necessarily attract attention, for they are then exceedingly voracious, devouring more during the last three or four days of their worm-life, than they had done during the whole of their previous existence. As soon as they are full grown they burrow into the earth, and, of course, are never seen again as worms.

Their increase and decrease is dependent on even more potent influences than those of a climatic nature. The worms are attacked by at least eight different parasites, and when we understand how persistent these last are, and how thoroughly they accomplish their murderous work, we cease to wonder at the almost total annihilation of the Army-worm the year following its appearance in such hosts. In the words of the late J. Kirkpatrick "their undue increase but combines the assaults of their enemies and thus brings them within bounds again."

We must also bear in mind, that besides these parasitic insects, there are some cannibal insects, such as the Fiery Ground-beetle (*Calosoma calidum*, Fabr.) and its larva,* which prey unmercifully upon the worms, while the "Mosquito Hawks" (*Libellulæ*) and bats, doubtless destroy many of the moths. Hogs, chickens and turkeys revel in the juicy carcasses of the worms, and sometimes to such an extent that, as I am informed by Mr. T. R. Allen, of Allenton, the former occasionally die in consequence, and the latter have been known to lay eggs in which the parts naturally white, would be green when cooked. Small birds, of various kinds, and toads and frogs also,

*First Report, Fig. 34.

come in for their share of this dainty food; while the worms, when hard pushed, will even devour each other.

NATURAL HISTORY OF THE ARMY-WORM.

Previous to the year 1861, but very little accurate knowledge had been acquired respecting the habits of the Army-worm, and nothing whatever of a scientific nature had been published.

A few very observing farmers ventured to predict its appearance during very wet summers succeeding very dry ones. They did not know why this was the case, but it was a fact that they had learned from experience. It was also known that the worm attacked only the grasses and cereals, that it was gregarious in its habits, and that it disappeared suddenly, in a manner as seemingly mysterious as that in which its advent was supposed to have been made.

These few facts were about the only ones of real value, respecting the habits of this insect, that could be gleaned from the statements of those who had suffered most from its ravages; while the subject seems to have been, up to that time, entirely ignored by entomological writers.

In 1861, however, its very general appearance, and the vast amount of damage it did, attracted the attention, not only of farmers, but of several well-known entomologists, among whom may be mentioned our late friends, Walsh, of Illinois, and Kirkpatrick, of Ohio; and Cyrus Thomas, of Illinois, Dr. Fitch, of New York, and J. H. Klippart, of Ohio.

As might have been expected, diverse conclusions were arrived at, and various theories entertained by these writers, and some very spirited correspondence between Messrs. Walsh and Thomas and Walsh and Klippart may be found in old files of both the *Ohio Farmer* and the *Prairie Farmer*.

The principal point of dispute was, whether the Army-worm wintered in the egg or chrysalis state, and, as a consequence, whether it was single or double-brooded.

It is needless to follow these gentlemen in their discussions, which were frequently caustic and pungent; but sometimes partook more of the character of personal wrangling than of a calm and conscientious search after truth. Two of the five parties mentioned above, are now in their graves, and while one of those yet living—Mr. Cyrus Thomas—believed in the two-brooded character of the insect; the other two evade the question entirely. Mr. Walsh took the ground that it was single-brooded, and the experience of the past year has convinced me that he was correct.

The Army-worm, like all other insects, hatches from an egg, and this egg is evidently deposited by the parent moth at the base of perennial grass-stalks. In Southern Missouri it hatches out about the middle of April; in the central part of the State about the first, and in the northern part about the middle of May; in Massachusetts,

about the middle of June, and in Maine about the middle of July. In every locality the worm goes underground about a month afterwards to assume the pupa or chrysalis state, and stays underground between two and three weeks. Hence, in the southern part of this State the moth appears about the fore part of June, and a month later in each successive locality as we go north, till in Maine, the period becomes the fore part of September. Of course, these dates will vary somewhat with the character of the seasons, and sometimes from local causes; but, broadly speaking, they will hold good.

The moths soon pair, and sometime during the summer and fall months, deposit their eggs in the positions already indicated. Many eggs are thus deposited in tame meadows, but there is little doubt in my mind that the great bulk of these eggs are deposited in low, damp situations, and if the fall should prove wet, instead of dry, many of them would perhaps get drowned out, and we should thus have another potent influence at work to decrease the numbers of the worm the succeeding year. I make this suggestion with all due consideration, for I have long since concluded that the instincts of insects, as of some of the higher animals, are not always sufficient to guard against all contingencies. It has been demonstrated beyond the possibility of a doubt, that the Plum Curculio deposits its eggs in fruit that overhangs water, and in other positions where the grub must inevitably perish; and certain flesh-flies are well known to deposit their eggs, by mistake, on flowers which have a putrescent smell. Darwin has remarked that a small South American bird (*Furnarius cunicularius*) which builds its nest at the bottom of a narrow, cylindrical hole, which extends horizontally several feet underground, is so incapable of acquiring any notion of thickness, that, although he saw specimens constantly flitting over a low clay wall, they continued vainly to bore through it, thinking it an excellent bank for their nests.* Many such instances of misdirected instinct might be cited, and they all lead me to believe that the female Army-worm moth would be just as likely to lay her eggs in situations where they would drown out, as in situations more favorable.

The above may be considered as the normal habit of the Army-worm; but exceptional individuals occur, perhaps one in a hundred, but demonstrably not as many as one in twenty, which lie in the chrysalis state all through the winter and do not come out in the moth state till the following spring. The proportion of those which lie over till spring is doubtless greater in the more northern States than it is with us. The great fault which Mr. Walsh made in his excellent paper on this insect, published in the Illinois State Agricultural Transactions for 1861, was, that he drew his lines too rigidly, and allowed of no exceptions to the rule which he laid down, of its single-broodedness. He also fell into an error in roughly estimating

*Voyage Round the World, p. 95.

the average life of the moth at from three to five weeks. I have often caught the moths, both in the fall and spring months, even in years when the worms themselves were unnoticed by farmers; and Dr. Levi Bartlett, formerly of Pesotum, Ills., informed me while he was practising in Chicago, that he had himself ascertained that they would sometimes live at least three months, and that he had often found them as late as October. We must also bear in mind that they do not all mature and issue from the ground together, even in the same locality; but that an interval of from six to eight weeks may intervene between the issuing of the first and last moths. With these facts before us it is easy to comprehend how some of the moths live long enough to deposit their eggs on newly sown fall grain, though grass meadows are more favorite resorts. It also becomes clear that the moths may sometimes lay their eggs before harvest upon growing grain, sufficiently high from the ground, for the egg to be carried off with the straw; and this accounts for several well authenticated instances of the Army-worm starting from stack-yards.

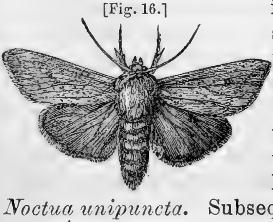
The Army-worm larva varies but little in appearance from the time it hatches to the time when it is full grown. Some specimens are a shade darker than others, but on many thousands examined, I have found the markings very uniform as represented in the annexed cut (Fig. 14). The general color is dingy black, and it is striped longitudinally as follows: On the back a broad dusky stripe; then a narrow black line; then a narrow white line; then a yellowish stripe; then a narrow sub-obsolete white line; then a dusky stripe; then a narrow white line; then a yellowish stripe; then a sub-obsolete white line; belly obscure green. Those who are more particular will find a detailed description at the end of this article.

[Fig. 14.]

The chrysalis (Fig. 15) is of a shiny mahogany-brown color, with two stiff converging thorns at the extremity, having two fine curled hooks each side of them. The general color of the moth is light reddish-brown or fawn color, and it is principally characterized by, and receives its name from, a white spot near the center of its front wings, there being also a dusky oblique line running inwardly from their tips. The accompanying illustration (Fig. 16), though darker than it should be, will show wherein it differs from the Southern Cotton Army-worm, notwithstanding the colors of the two moths are nearly alike. Our Army-worm moth was first described by the English Entomologist Haworth in the year 1810, in his *Lepidoptera Brittanica*, page 174, as *Noctua unipuncta.* Subsequently the French Entomologist Guenée

[Fig. 15.]

[Fig. 16.]



(*Noctuelites* I, p. 77) overlooking the former's description, and regarding it as a new species, named it *Leucania extranea*. Of course Haworth's name takes the precedence. It is considered a common species even in European collections, and Guenée mentions it as occurring in Brazil. A variety without the white spot occurs in Java and India, and still another, lacking the white spot, and having a dark border on the hind wings, occurs in Australia; while an occasional specimen has been captured in England. A figure is given in Stainton's Entomologist's Annual for 1860, of one captured there in 1859, but if the figure be a correct one, the specimen is much lighter than ours, and the characteristic white spot is not nearly so conspicuous.

PARASITES OF THE ARMY-WORM.

THE RED-TAILED TACHINA FLY—*Exorista leucaniæ*, Kirk.—To one who has never before seen the Army-worm in its might, the sight of the myriads as they return thwarted in their endeavors to cross, or of the living, moving and twisting mass which sometimes fills a ditch to the depth of several inches; is truly interesting. At Hannibal I was much surprised to find that fully nine worms out of every ten had upon the thoracic segments, just behind the head, from one to four minute, narrow, oval white eggs, about 0.04 inch long, attached firmly to the skin; and my companions were equally surprised when I informed them that these were the eggs of a parasite, and that every one of the worms which had such eggs attached to it, would eventually succumb to one of the maggots these eggs produced. The eggs are no doubt deposited by the mother fly just behind the head, so that the worm may not reach the young maggots when they hatch, and be enabled to destroy them with its jaws. I have found several different kinds of cut-worms with just such eggs attached invariably on the back just behind the head. They are glued so strongly to the skin of the worm that they cannot be removed without tearing the flesh.

The large two-winged parasitic flies which deposited these eggs, were wonderfully numerous, buzzing around us and about the worms like so many bees, and the moment one was caught, I recognized it as the Red-tailed Tachina Fly. This is one of the most common and abundant of the Army-worm parasites, and attacks it in widely different parts of the country. I have also bred the same fly from the Varigated cut-worm (larva of *Agrotis inermis**), and a variety of it from our common large Cecropia worm, which is often found on apple and other fruit trees. It was first very briefly and imperfectly described as *Exorista leuca*[*i*]*æ*, by the late J. Kirkpatrick, in the Ohio Agricultural Report for 1860, page 358, and was subsequently much more fully described as *Senometopia* [*Exorista*] *militaris* by Mr. Walsh, in his Army-worm paper already referred to. Of course Mr. Kirkpatrick's

*First Report, p. 72.

name has the priority, but I introduce Mr. Walsh's original description of the fly and likewise the very same figure (Fig. 17) which he used to illustrate it.

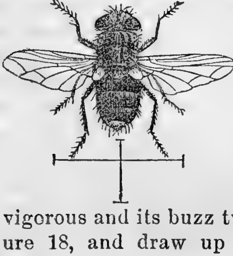
[Fig. 17.]

Exorista leucaniæ—Length, .25 to .40 inches, or from 6 to 10 millimetres, the females not exceeding .30 inch. Face silvery, with lateral black hairs only on the cheeks, at the top of which is a black bristle. Front, golden-olive, with a black central stripe, and lateral black convergent hairs. Occiput, dusky. Labium, brown, with yellowish hair. Maxipalps, rufous. Eyes, cinnamon-brown, covered with very short dense whitish hair. Antennæ, two basal joints, black, with black hairs; third joint, flattened, dusky, and from two and a half to three times the length of the second joint; seta, black. The entire hinder part of the head covered with dense whitish hair. Thorax glabrous, bluish-gray, lighter at the side, with four irregular black vittæ, and black hairs and bristles. Scutel, reddish-brown, whitish behind, glabrous, with black hairs and bristles. Pectus, black, glabrous, with hairs and lateral bristles. Legs, black, hairy; thighs, dark cinereous beneath; pulvilli, cinereous. Wings, hyaline; nervures, brownish; alulæ, opaque greenish-white. Abdomen, first joint black; second and third, opalescent in the middle with black and gray, and at the sides with rufous and gray; last joint, rufous, slightly opalescent at the base with gray; all with black hairs and lateral bristles. Beneath, the first joint is black, the others black, margined with rufous, all with black hairs. In the male the space between the eyes at the occiput is one-seventh of the transverse diameter of the head; in the female it is one-fourth. The colors of the abdomen sometimes "grease" and fade in the dried specimen.

Bred fifty-four specimens from about the same number of Army-worms. Described from eight males and six females. Two species, similarly marked with rufous, but generally distinct, occur at Rock Island.

Mr. Kirkpatrick also described on the same page of the Ohio Report for 1860, another species (?) to which he gave the name of *Osten Sackenii*. But upon the very face of it, this proves to be but a smaller specimen of his *leucaniæ;* for the characters on which he would build this other species, are none of them constant. He says it differs from *leucaniæ* in its smaller size; in the gray bands on the abdomen not being so distinct; in some little variation in the position of the brown, and in the *pulvill[i]æ* being more distinctly gray. Now *leucaniæ* varies from 0.25 to 0.40 inch in length; the brown on the abdomen is opalescent and varies; the pulvilli and gray abdominal markings vary far more in depth of shade than there set forth, and the abdomen in fact, if the least greasy, often loses all trace of gray.

[Fig. 18.]



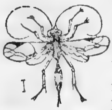
The Yellow-tailed Tachina Fly, (*Exorista flavicauda*, N. Sp.)—We have another species in Missouri however, which may be called the Yellow-tailed Tachina Fly, and which differs so notably from the Red-tailed species that it may be recognized even on the wing. It is almost twice as large, and the head instead of being narrower than the thorax as in *leucaniæ* is broader. Its flight is also more vigorous and its buzz twice as loud, I represent this species at Figure 18, and draw up the following description for the scientific reader:

Exorista flavicauda, N. Sp.—Length, 0.35 to 0.50 inch. *Head* broader than thorax; face, silvery-white, the cheeks inclining to yellow, with lateral black hairs extending to near the base of

antennæ, and one stiffer and longer bristle at top of cheeks; front, dusky, ferruginous, with two rows of black converging bristles; divided by a broad depressed stripe of a brighter ferruginous color and without bristles; occiput bright ferruginous; labium ferruginous with hairs of same color; maxipalps rufous; eyes dark mahogony-brown, and *perfectly smooth;* antennæ, two basal joints rufous, with black hairs, third joint flattened, dusky, and thrice as long as second; seta, black; entire hinder part of head covered with dense white hairs. *Thorax,* more decidedly blue than in *leucaniæ, broader* (instead of narrower) in front than behind; the vittæ less distinct; scutel of same color as thorax. *Abdomen,* stout and more cylindrical than in *leucaniæ;* first joint dark bluish-gray; second, light bluish-gray, becoming darker along the middle, at sides and at lower border; third joint, like second above, but golden-gray at sides (no rufous); last joint *entirely* yellow or pale orange, with no other color and but few black bristles around anus. *Wings* more dusky than in *leucaniæ;* alulæ, opaque bluish-white. *Legs,* black; pulvilli pale yellow.

Described from one captured, 4 bred ♀. Space between eyes at occiput fully one-third the width of head.

[Fig. 19.]



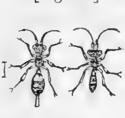
To give an idea of the other parasites which attack the Army-worm, I will briefly allude to them, and transmit descriptions for the scientific reader.

THE GLASSY MESOCHORUS—*Mesochorus vitreus,* Walsh. (Fig. 19.)—Length of body .08 inch, (two millimetres,) to .13 inch, (three millimetres); the small specimens being parasitic on the Army-worm and the large ones captured in Rock Island county. Male, general color light rufous. Eyes and ocelli, black; antennæ fuscous, except toward the base. Upper surface of thorax in the larger specimen fuscous; intermediate and posterior tibiæ with spurs equal to one-fourth of their length; posterior knees slightly dusky; tips of posterior tibiæ distinctly dusky. Wings hyaline; nervures and stigma, dusky. Abdomen, a translucent yellowish-white in its central one-third; the remaining two-thirds piceous-black, with a distinct narrow yellowish annulus at the base of the third joint. In the larger specimen, which seems to be immature, the basal abdominal joint, and the articulations of the terminal joints are light rufous. Appendiculum of the abdomen composed of two extremely fine setæ, thickened at their base, whose length slightly exceeds the extreme width of the abdomen.

The female differs from the male, in the head from the mouth upwards being piceous. The thorax and pectus, in all three specimens, are also piceous-black. Abdomen as in the smaller male. Ovipositor, which is dusky, slightly exceeds in length the width of the abdomen.

THE DIMINISHED PEZOMACHUS—*Pezomachus minimus,* Walsh, (Fig. 20.).—Length of the body .07 to .10 inch., (2 to 2½ millimetres). Male, general color, piceous. Eyes black; antennæ black, except toward the base, where they are light rufous. Legs rufous; hind legs a little dusky. Abdomen narrowed; second and sometimes the third joint annulate with rufous at tip. The female differs from the male in the thorax being almost invariably rufous, and in the first three abdominal joints being generally entirely rufous, with a piceous annulus at the base of the third, which is sometimes absent. The abdomen is also fuller and wider. Ovipositor dusky, equal in length to the width of the abdomen. No vestige of wings in either sex, and the thorax contracted and divided as in *Formica.*

[Fig. 20.]



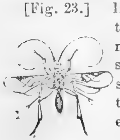
[Fig. 21.]

Fig. 22.]

The larvæ of this species issue from the body of the Army-worm, and spin on its skin, small cocoons symmetrically arranged side by side, and enveloped in floss (Fig. 21). It belongs to a genus of wingless Ichneumons, and in its turn is preyed upon by a small *Chalcis* fly (*Chalcis albifrons,* Walsh) which is represented at Figure 22.

THE MILITARY MICROGASTER—*Microgaster militaris,* Walsh, (Fig. 23).—Length 0.07 inch. Head black; palpi whitish; antennæ fuscous above, light brown beneath towards the base. Thorax black, polished, with very minute punctures. Wings hyaline; nervures and stigma fuscous; lower nervure of marginal, and exterior nervure of second submarginal cellule entirely obsolete. Lower nervule of third and terminal submarginal cellule, hyaline. Legs light rufous, posterior pair, with knees and tips of tibiæ fuscous. Abdomen black, glabrous, highly polished. Ovipositor not exserted.

[Fig. 23.]



The cocoons of this little parasite are spun in irregu-

lar masses, and are so completely covered with loose white silk that as a whole they look like little pieces of fine wool attached to the back of the Army-worms. They were very numerous last year in this State, and were sent to me by several correspondents, under the supposition that they were the eggs of the Army-worm. Nothing could be more unsafe and erroneous than such a conclusion; for instead of giving birth to new generations of the Army-worm they produce the little flies which are its most deadly foes. All the numerous specimens which I bred accord exactly with the above named species. This parasite is also in its turn infested by two parasites (*Glyphe viridascens* (Fig. 24) and *Hockeria perpulcra*, Walsh), but while over 90 per cent. of Army-worms are killed by primary parasites, only about 18 per cent. of these primary parasites are destroyed by the secondary parasites.

[Fig. 24.]

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THE PURGED OPHION—*Ophion purgatus*, Say*.—Body pale honey-yellow, somewhat sericeous; antennæ rather longer than the body; orbits yellow, dilated before, so as to occupy the greater part of the hypostoma; ocelli large, prominent; wings hyaline; stigma slender; first cubital cellule with two opaque, subtriangular spots; no areolet; metathorax with a single, raised, rectilinear, transverse line, near the base. Length, seven-tenths of an inch.

[Fig. 25.]

This large Ichneumon Fly (Fig. 25) has been bred from the Army-worm. The ovipositor is very short, and instead of piercing the skin of her victim as do all the other Ichneumons that have been described, the female Ophion simply attaches her egg, which is bean-shaped, by a pedicle to the skin. The footless grub which hatches from this egg does not entirely leave the egg-case, but the last joints of its body remain attached to the shell, while it reaches over, and with its sharp jaws gnaws into the side of the worm (Packard). This Ophion has been taken in Maine, New York, Massachusetts, Indiana, Illinois, Missouri and Carolina and doubtless occurs all over the United States.

THE ARMY-WORM ICHNEUMON FLY—*Ichneumon lucaniæ*, Fitch.—Dr. Fitch* has briefly described another true Ichneumon Fly under the above name, which he bred from the Army-worm.

Thus we have seven distinct and true parasites which attack this worm, and besides these, two others, undescribed, are figured in Harris's Injurious Insects (last edition p. 630), swelling the number to nine. Can we longer wonder that this dreaded foe to the farmer, never molests his crops for two successive years?

HABITS OF THE ARMY-WORM, AND SUGGESTIONS FOR ITS DESTRUCTION.

Since the great bulk of the eggs of the Army-worm are deposited in the summer and fall months in grass swamps and grass mead-

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* *Ophion purgatus*, Say.=*O. lateralis*, Brullé.

*N. Y. Reports, Vol. III, p. 126.

ows, and the eggs do not hatch out till the following spring, it becomes obvious that burning over grass meadows in the winter or very early in the spring, must destroy most of the eggs. Many instances might be given where, in past years, burnt grass escaped the worm, while all the unburnt grass in the neighborhood was badly infested, and in one instance part of a meadow having been accidentally burnt and part remaining unburnt, the burnt portion in the following summer, had no Army-worms on it, and the unburnt portion swarmed with them. Thus, if you burn your meadows over annually you will seldom be troubled with this pest, and if you get your neighbors to do the same thing, and in addition will also burn all the wild grass around you, the Army-worm will never do you any damage. The remedy is so simple that all can apply it. The best time to do this burning, is, as all practical men well know, in the dead of the year, when the ground is frozen; the roots of the grass are then unharmed by the fire. Of course, ploughing the land late in the fall or late in the spring, will have the same effect as burning it, for if the eggs are turned two or three inches underground they will surely rot and fail to hatch. Here we see, as in the case of the Canker-worm, which I shall presently treat of, and as in the case of almost every other noxious insect, it is necessary accurately to investigate the habits and puculiarities of each one before we can effectually counterwork it.

During my visit to Hannibal last June, I ascertained that the worms orignated in a large 100-acre field of very rich blue-grass, belonging to Mr. W. R. Flowerree. This gentleman makes a business of fattening cattle, and intended feeding off the grass in the fall; but that same blue-grass field *had neither been pastured nor plowed the year before;* and this was the very reason why the worms originated there, as the reader will readily perceive from the foregoing account of the insect's habits.

The Army-worm when traveling will scarcely turn aside for anything but water, and even shallow water-courses will not always check its progress; for the advance columns will often continue to rush head-long into the water until they have sufficiently choked it up with their dead and dying bodies, to enable the rear guard to cross safely over. I have noticed that after crossing a bare field or bare road where they were subjected to the sun's rays, they would congregate in immense numbers under the first shade they reached. In one instance I recollect their collecting and covering the ground five or six deep all along the shady side of a fence for about a mile, while scarcely one was seen to cross on the sunny side of the same fence. Though they will nibble at clover, they evidently do not relish it, and almost always pass it by untouched. They will eat any of the grasses, and are fond of oats, rye, sorghum, corn and wheat, though they seldom devour any other part but the succulent leaves. They often cut off the ears of wheat and oats and allow them to fall to the ground, and

they are perhaps led to perform this wanton trick, by the succulency of the stem immediately below the ear. South of latitude 40° they generally appear before the wheat stalks get too hard, or early enough to materially injure it; but north of that line, wheat is generally too much ripened for their tastes, and is sometimes even harvested before the full grown worms make their advent.

I have heard of the Army-worm, sometimes passing through a wheat field when the wheat was nearly ripe, and doing good service by devouring all the chess and leaving untouched the wheat; but the following item from Collinsville, Illinois, which appeared in the *Missouri Democrat*, contains still more startling facts, and would indicate that even a foe to the farmer as determined as this, may sometimes prove to be his friend.

"HARVEST AND CROPS.—Notwithstanding the unfavorable weather, many farmers have commenced the wheat harvest. The yield in this immediate vicinity will be superabundant. Some fields were struck with rust a few days since, but the Amry-worm making its appearance simultaneously, stripped the straw entirely bare of blades and saved the berry from injury. These disgusting pests have saved thousands of dollars to farmers in this neighborhood. A few fields of corn and grass have been partially destroyed, but by ditching around fields, the worm's ravages have been confined within comparatively narrow limits."

The worms may be prevented from passing from one field to another by judicious ditching. Mr. Trabue has large meadows, separated only by a road from the blue-grass field of Mr. Flowerree; and he thought he could keep out the worms by simply making a V-shaped ditch; believing that they could not crawl over, so long as the earth crumbled. The first evening after it was dug, this ditch seemed to be effectual, and the bottom was covered with one seething, twisting mass of the worms; but a heavy rain came on in the night following, after which they crossed without difficulty. Mr. Jas. Dimmitt however, who had 80 acres of wheat adjoining the fatal blue-grass field, effectually protected it by surrounding it with a ditch which had the inner side slanting under, towards the field it was intended to protect. It was indeed most fortunate that Mr. Dimmitt had hit upon the true method in the beginning, for his wheat was yet in that soft state, in which many of the ears would have been devoured or cut off; and friend Trabue was not long in profiting by his example.

A good plan to destroy the worms which accumulate in the furrow or ditch is to burn straw in it; for the fire not only kills the worms, but makes the earth in the ditch friable and more efficient in preventing their ascent. A heavy roller passed over a field will kill almost every worm, and I have already stated that hogs and poultry will devour great numbers of them. But it is always better and easier to prevent than to cure.

LEUCANIA UNIPUNCTA, Haw.—*Larva*—General color dingy black, with the piliferous spots, placed in the normal position, but scarcely visible, though the soft hairs arising from them are easily seen with a lens. Four lateral light lines, of almost equal thickness, and at about equal

distance from each other, the two uppermost white, the two lowermost yellow; a much less distinct dorsal white line, frequently obsolete in middle of segment, and always most distinct at the divisions: a jet black line immediately above the first lateral white one, the dorsum near it, thickly mottled with dull yellow, but becoming darker as it approaches the fine dorsal white line, along each side of which it is perfectly black. Space between lateral light lines 1 and 2, dull yellow, the white lines being relieved by a darker edge; that between lines 2 and 3 almost black, being but slightly mottled along the middle; that between 3 and 4 yellow, mottled with pink-brown, and appearing lighter than that between 1 and 2. Venter greenish-glaucous, mottled and speckled with neutral color, especially near the edge of the 4th lateral line. Legs glassy and of same color as venter, those on thoracic segments with black claws, those on abdomen with a large shiny black spot on the outside. Stigmata oval, black, and placed in the 3d lateral light line. Head pale grayish-yellow, speckled with confluent fuscous dots; marked longitudinally by two dark lines that commence at the corners of the mouth, approach each other towards the centre, and again recede behind; on each side are four minute polished black eyelets, placed on a light crescent-shaped ridge, and from each side of this light ridge a dark mark extends more or less among the confluent spots above. Described from numerous average living specimens.

Imago—Front wings: general color tarnished yellowish-drab, inclining to russet; sprinkled with blackish atoms, the basal half of the costal margin being lighter than the rest. Ordinary spots brighter than rest of wing, being either fulvous or rust-red, each having ordinarily a tarnished centre, the reniform or "kidney-shaped" spot, having at its lower border a conspicuous white point, indistinctly surrounded by blackish, from which point the moth takes its name; between this point and the terminal border a transverse row of black dots (one on each vein) much arcuated above; and inside and parallel with it a less distinct row, the dots forming which, are between the nerves; an oblique dark streak, shaded off gradually posteriorly, but relieved anteriorly by the same bright color as the ordinary "spots" runs from the head of this row of dots to the apex of the wing; nerves more or less marked with white, especially towards their tips; posterior or terminal border with a row of black spots between the nerves; fringes same color as wing, with a narrow dusky line inside their middle. Hind wings partly transparent, smoky-brown, with a slight purplish lustre, the veins, lunule, and terminal border more dusky; fringes pale yellow with a dusky middle line.

Under surfaces opalescent yellowish-white, the front wings shaded with smoky-gray, the costa narrowly, and the terminal margin broadly freckled with dusky specks, the fringes and a shade near the apex flesh-color, and a distinct dusky band across their outer one-fourth, narrower but darker on the costa than in the middle of the wing: the hind wings with the lunule distinct and also speckled anteriorly and posteriorly, the basal edge of the posterior portion well defined by a series of black dots on the nerves.

Head and shoulders of same color as basal part of costa; thorax same as front wings; abdomen same as hind wings; beneath all more uniformly gray.

INSECTS INFESTING THE SWEET-POTATO.

TORTOISE-BEETLES.

(Coleoptera, Cassidæ.)

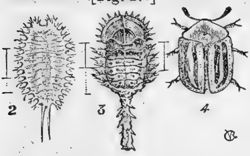
In my First Report I described eleven different and distinct insects which habitually prey on the common Irish Potato (*Salanum tuberosum*). I will now give an account of the worst insect enemies of the Sweet-Potato (*Ipomea batatus*), all of which attack that plant in this State. Before doing so, however, it will be as well to remark, that one species belonging to the same family as those which feed on the Sweet-Potato, and which is quite frequently met with in Missouri, namely, the Clubbed Tortoise-beetle (*Deloyala clavata*, Oliv. Fig. 26,)

[Fig. 26.]

feeds in reality on the common Irish Potato, thus swelling the number of insects which injuriously affect that most valuable esculent, to a round dozen. The larva of the Clubbed Tortoise-beetle is not yet known, and it is the perfect insect which has been found to attack the Potato. This is doubtless the species which Mr. Huron Burt of Williamsburg, Callaway county, referred to in the *Journal of Agriculture* of June 6th, 1868, as "a scale-like, terrapin-shaped hard insect, spread out like a flying-squirrel," that adhered tenaciously to the leaves of his potato plants. By referring to Figure 26 the reader will not be slow to learn why these beetles are called Tortoise-beetles, for the patches of dark opaque color which extend on the thin projecting semi-transparent shell of that species, remind one very forcibly of the paws of a mud-turtle. The true legs however, which, as in all other insects, are six in number, and which in this species, are so short that they scarcely reach beyond the thin shield-like crust that extends from the body, may readily be seen when the insect is turned upside down.

The insects which attack the Sweet-Potato are few in species, and belong almost entirely to this group of Tortoise-beetles. With

[Fig. 27.]



the exception of the Cucumber Flea-beetle (*Haltica cucumeris*, Harr.), figured and described on page 101 of the First Report, and a few solitary caterpillars, I have never found any other insects on this plant; but these Tortoise-beetles are of themselves sufficiently numerous in individuals and species to often entirely destroy whole fields of this esculent, and they are especially severe on the plants when newly transferred from the hot-bed.

These insects are at present included in the great CHRYSOMELA family of beetles, though they were formerly placed in a separate family (CASSIDIDÆ) by themselves, and there certainly are few groups more strongly characterized. They are almost all of a broad subdepressed form, either oval or orbicular, with the thorax and wing-covers so thoroughly dilated at the sides into a broad and flat margin, as to forcibly recall the appearance of a turtle, whence the popular name. Many have the singular power, in a greater or less degree, of changing their color when alive, and as I shall show further on, some of them shine at will with the most brilliant metallic tints.

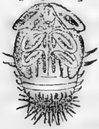
Insects, as with the higher animals, usually void their excrement in such a manner that they effectually get rid of it, and in some cases they take pains to fling it as far from them as possible, by means of their hind legs. I have especially noticed this cleanly habit in the Oblong-winged Katydid (*Phylloptera oblongifolia*, DeGeer), of which I have had numbers breeding in confinement during the past two summers. They almost always fling their excrement straight

from them, so that if they are in a horizontal position, it adheres to the sides of their cages instead of falling to the bottom. In the great majority of insects the anus is situated at, or near the last ring, and usually on the ventral side, so that the fæces are easily left behind; but the larvæ of several species of beetles that have the peculiar habit of covering themselves with their own excrement, have the anus not on their bellies, but on their backs. The Three-lined Leaf-beetle* (*Lema trilineata*) has this habit, and is enabled to cover itself by the singular position of the anal vent which is on the back of the last segment. A closely allied European species, but belonging to a different genus (*Crioceris merdigera*) has the same habit. In this country there is also another yellowish oval jumping beetle (*Blepharida rhois*, Forster), which in the larva state covers itself with its excrement. In this instance the anus is at the end of the last segment, but it is sufficiently extensile at the will of the insect to allow of the accomplishment of the feat. This last larva is a disgusting looking thing, and I found it last year very abundant along the line of the Iron Mountain Railroad, on all three of the Sumachs—*Rhus aromatica*, *glabra* and *copalina*—preferring them in the order of their naming.

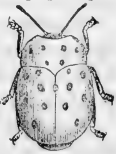
But the larvæ of the Tortoise-beetles are *par excellence* the true dung carriers, for they excel all others in this medigerous art. In the instances related above, the load is carried immediately on the back, but our Tortoise-beetles are altogether more refined in their tastes, and do not allow the dung to rest on the body, but simply shade themselves with a sort of stercoraceous parasol.

The larvæ of all the species that have been observed to feed on the Sweet-Potato are broad and flattened like the beetles, and have the margin of the body furnished with spines which are often barbed, (Fig. 27, 2). They all belong to the genera *Cassida* and *Coptocycla*, and there are thirty-two of these spines, or sixteen on each side of the body. Four of these are situated on the prothorax, which forms two anterior projections beyond the common margin; four of them—the two anterior ones longer than the others—are on each of the two following thoracic segments, and each of the abdominal segments is furnished with but two. There are nine elevated spiracles each side superiorly, namely, one immediately behind the prothorax and eight on the abdominal segments. The fore part of the body is projected shield-like over the head, which is retractile and small.

[Fig. 28.]



[Fig. 29.]



In a closely allied genus (*Chelymorpha*) to which belongs a brick-red insect with black spots (*Ch. cribraria*, Fabr., Fig. 28, pupa; 29 beetle) found upon Milkweed (*Asclepias*), and which has the body greatly rounded above, with scarcely any lateral flange, the larva, as observed by Dr. Packard, has the prickles smooth and not

*First Rep., p. 100.

sprangling. In another genus also (*Physonota*) to which belongs the Five-dotted Tortoise-beetle (*Ph. quinquepunctata*, Walsh & Riley,

[Fig. 30.]

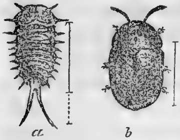

a b

Fig. 30, *b*), and which is intermediate in form between the last named genus (*Chelymorpha*) and those with the body greatly flattened (*Cassida*, *Coptocycla*, *Deloyala*) the prickles of the larva are also smooth and only 20 in number, i. e., 10 on each side, as may be seen by referring to Figure 30, *a*. Mr. Walsh found this insect in Northern Illinois, and though we do not know upon what particular plant it feeds, yet from analogy we may infer that it subsists on some Composite flower, as other species belonging to the same genus are known to do.

Almost all the larvæ of the beetles belonging to the great CHRYSOMELA family, of which the Colorado Potato Bug may serve as an example, have, besides the six legs at the anterior end of the body, an additional proleg, or protuberance which serves as such, at the posterior end; but the larvæ of our Tortoise-beetles have no such proleg, and the six anterior legs are short, thick and fleshy, and with the retractile head, give these larvæ, from a side view, as great a resemblance to a turtle as have the beetles.

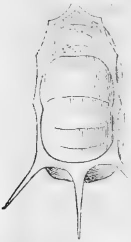
Though lacking an anal proleg, however, they are characterized by having a movable forked tail, in the shape of two long prong-like horny filaments which both spring from a broad neck situated immediately above the anus. The anus projects and curves over the back at the will of the insect, and by the aid of this fork and of some of the lateral spines, it forms the parasol of dung which so nicely protects it.

When we read of those Hottentots who cover different portions of their bodies with the uncleaned intestines of sheep and oxen, we feel shocked at such barbarism, and can scarcely comprehend how human beings can defile themselves with the like disgusting materials. Such men must be pitiable indeed, for they can have no other object than the gratification of their filthy and beastly pleasures. There is nothing so repulsive about our insect Hottentots, for the dung parasol of our Tortoise-beetles has neither offensive odor or appearance, and its true character is generally sufficiently disguised by being intermixed with the cast-off skin and prickly spines; and though those species, first referred to, which directly cover their backs, often look sufficiently unclean, we know that they thus act at Nature's bidding and for a useful purpose.

All the Tortoise-beetle larvæ which I have bred to the perfect beetle state, have come to their growth in about three weeks after hatching. They cast their skins at three successive periods, and these skins are slipped on to the fork, where in most instances they remain. On carefully detaching from a full grown larva the dung with which these skins are mixed, these three successive skins are easily recognized, the smallest being at the extremity and the largest at the base

of the fork. They are especially recognizable in the Mottled Tortoise beetle (*Cassida guttata*, Oliv., Fig. 36,) mentioned below, which removes most of its dung before each moult.

Fig. 31.



The eggs from which these larvæ hatch, are deposited singly upon the leaves, to which they are fastened by some adhesive substance. They are of irregular angular form; flat, and somewhat narrower at one end than the other; ridged above and at the sides, but smooth and obovate below. They are usually furnished with spine-like appendages, which however are sometimes entirely lacking. They look, in fact, very much like miniature specimens of those curious skate-barrows or Mermaid's purses, which are found so commonly along the sea-shore, and which are the empty egg-shells of certain kinds of Ray-fish or Skate. Those of the common Golden Tortoise-beetle (Fig. 31,) are 0.04 inch long, and of a dull, dirty white color.

The Tortoise-beetle larvæ, when full grown, fasten the last two or three joints of the body to the underside of a leaf, by means of a sticky secretion, and in about two days change to pupæ. The pupa of those species which have 32 barbed spines, is flat with usually four or five broad but thin and transparent serrated leaf-like appendages on each side of the abdomen, and the prothorax, which is greatly dilated and covers the head, is furnished around the edge with smaller barbed spines. The broad leaf-like spines at the edges of the body are bent under while the transformation is being effected, but are soon afterwards stretched stiffly out with a forward slant. The pupa loses the pronged tail, but as the old larval skin is left adhering to the terminal segments the prong of dung still protects it in most cases. The legs and antennæ are not free in this, as in the pupæ of most other beetles, but are soldered together as in the chrysalis of a butterfly, and yet it has the power of raising itself up perpendicularly upon the tail end by which it is fastened. The pupa state lasts about a week.

Having thus spoken in general terms of this anomalous group of beetles, I shall now refer more particularly to a few of the species. Most of those mentioned below infest the Sweet-Potato both in the larva and perfect beetle states. They gnaw irregular holes and when sufficiently numerous entirely riddle the leaves. They usually dwell on the underside of the leaves, and are found most abundant during the months of May and June. There must be several broods during the year, and the same species is often found in all stages, and of all sizes at one and the same time. In all probability they hybernate in the beetle state.

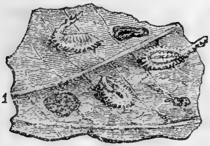
I have proved by experiment that Paris green—one part of the green to two of flour—when sprinkled under the vines, will kill these insects, though not near so readily as it does the Colorado Potato

Bug. Moreover, as these Tortoise-beetles usually hide on the under side of the leaves, and as the vines trail on the ground, it is very difficult to apply the powder without running some risk from its poisonous qualities. I therefore strongly recommend vigilance when the plants are first planted, and by the figures and descriptions given below the reader will be enabled to recognize and kill the few beetles which at that time make their appearance, and thus nip the evil in the bud. The Bermuda and Brazilian Sweet-Potato plants are more vigorous than the Nansemond, and less liable to be attacked.

THE TWO-STRIPED SWEET-POTATO BEETLE—*Cassida bivittata,*, Say.

This is the most common species found upon the Sweet-Potato,

[Fig. 32.]


1

and seems to be confined to that plant, as I have never found it on any other kind. Its transformations were first described by myself in the *Prairie Farmer Annual*, for 1868, (p. 53.) The larva (Fig, 27, 2 enlarged; Fig. 32, natural size), is dirty-white or yellowish-white, with a more or less intense neutral-colored longitudinal line along the back, usually relieved by an extra light band each side. It differs from the larvæ of all other known species in not using its fork for merdigerous purposes. Indeed, this fork is rendered useless as a shield to the body, by being ever enveloped, after the first moult, in the cast-off prickly skins, which are kept free from excrement. Moreover, this fork is seldom held close down to the back, as in the other species, but more usually at an angle of 45° over or from the body, thus suggesting the idea of a handle. In Kirby & Spence's Introduction (p. 426), may be found the following passage in reference to the positions in which the fork of the larvæ of these Tortoise-beetles is carried: "The instrument by which they effect this is an anal fork, upon which they deposit their excrement, and which in some is turned up and lies flat upon their backs; and in others forms different angles, from very acute to very obtuse, with their body; and occasionally is unbent and in the same direction with it." Reaumur is referred to as authority for these statements, and the language would lead us to suppose that the forks were thus variously carried by different species; but Reaumur never said anything of the sort. His language has been poorly rendered, for he distinctly referred to the different positions which the same insect could give to the fork, and I believe that the peculiarity mentioned above has never been observed in the larvæ of any other species of the genus.

When full fed, this larva attaches itself to the underside of the leaf, and in two days the skin bursts open on the back, and is worked down towards the tail; when the pupa, at first pale, soon acquires a dull brownish color, the narrow whitish tail, which still adheres posteriorly, being significant of the species. See (Fig. 27, 3.)

The beetle (Fig, 27, 4) is of a pale yellow, striped with black, and though broader and vastly different scientifically, still bears a gen-

eral resemblance to the common Cucumber-beetle (*Diabrotica vittata*, Fabr.)

These beetles may be seen quite thick around young peach and apple trees quite early in the season, and a little later they venture into the trees and pair off; but as soon as the Sweet-Potato plants are set, they leave everything else for them.

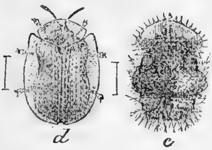
THE GOLDEN TORTOISE-BEETLE—*Cassida aurichalcea*, Fabr.

Next to the preceding species, the Golden Tortoise-beetle is the most numerous on our sweet-potatoes; but it does not confine its injuries to that plant, for it is found in equal abundance on the leaves of the Bitter-Sweet and on the different kinds of Convolvulus or Morning Glory. The lava (Fig. 33, *a*, natural size *b*, enlarged with the dung taken from the fork), is of a dark brown color with a pale shade upon the back. It carries its fæcifork directly over the back, and the excrement is arranged in a more or less regular trilobed pattern. The loaded fork still lies close to the back in the pupa, which is brown like the larva, and chiefly characterized by three dark shades on the transparent prothorax, one being in the middle and one at each side, as represented at Figure 34, *c*.

[Fig. 33.]

The perfect beetle (Fig. 34, *d*), when seen in all its splendor, is one of the most beautiful objects that can well be imagined. It exactly resembles a piece of golden tinsel, and with its legs withdrawn and body lying flat to a leaf, the uninitiated would scarcely suppose it to be an insect, did it not suddenly take wing while being observed. At first these beetles are of a dull deep orange color, which strongly relieves the transparent edges of the wing-covers and helmet, and gives conspicuousness to six black spots, two (indicated in the figure) above, and two on each side. But in about a week after they have left the pupa shell, or as soon as they begin to copulate, they shine in all their splendor, and these black spots are scarcely noticed.

[Fig. 34.]

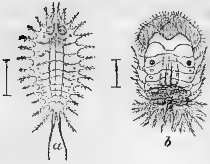


THE PALE-THIGHED TORTOISE-BEETLE—*Cassida pallida*, Herbst.

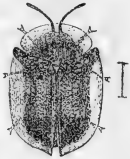
This species can scarcely be distinguished from the preceding. It is of a somewhat broader, rounder form, and differs in partially lacking the black spots on the wing-covers, and in having the thighs entirely pale yellow, while in *aurichalcea* they are black at the base. It likewise feeds upon the Sweet-Potato, and its larva differs only from that of the former, in its spines being brighter and lighter colored, and in having a dull orange head, and a halo of the same color on the anterior portion of the body.

THE MOTTLED TORTOISE-BEETLE—*Cassida guttata*,* Oliv.

[Fig. 35.]



[Fig. 36.]

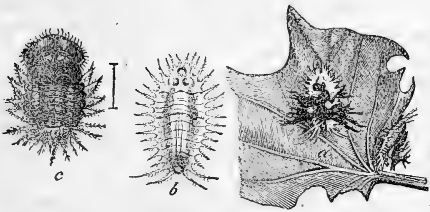


This species (Fig. 36) which is the next most common of those found on the Sweet-Potato in the latitude of St. Louis, is at once distinguished from all the others here described, by being usually black, with the shoulders black to the extreme edge of the transparent wing-covers. It is a very variable species, and is frequently more or less speckled or mottled with gold, while more rarely it has a uniform golden appearance.†

The larva, which is represented enlarged and with the dung removed at Figure 35, *a*, is of a uniform green color, with a bluish shade along the back, which shade disappears however whenever the insect has fasted for a few hours. It carries its dung in irregular broad masses, often branching as in the species next to be described. The pupa (Fig. 35, *b*,) is also of a uniform green color, with a conspicuous black ring around the base of the first abdominal pair of spiracles. Before changing to pupa and previous to each moult, this larva is in the habit of removing the dung from its fork.

THE BLACK-LEGGED TORTOISE-BEETLE—*Cassida nigripes*, Oliv.

[Fig. 37.]



This species, which is likewise found on the Sweet-Potato, is a little the largest of those heretofore mentioned. The beetle (Fig. 38) has the power, when alive, of putting on a golden hue, but is not so brilliant as *C. aurichalcea*, from which species it is at once distinguished by its larger size and by its black legs and three large conspicuous black spots on each wing-cover. The larva (Fig. 37, *b*,) is of a pale straw color with the spines, which are long, tipped with black; and besides a dusky shade along each side of the back, it has two dusky spots immediately behind the head, and below these last, two larger crescent marks of the same color. The dung is spread in a characteristic manner, extending laterally in long shreds or ramifications. (See Fig. 37, *a*.) The pupa

[Fig. 38.]

* This insect is referred by Boheman to the genus *Co tocycla*, which differs from *Cassida* by more slender, not distinctly clavate and nearly filiform antennæ.

† This species has very probably been described under different names. It is *C. cruciata*, Fabr.; *C. signifer*, Herbst, and from larvæ found on the same batch of plants, and differing in no respect whatever, I have bred specimens which were determined by Le Conte as *C. trabeata*, Lec.

(Fig. 37, *c*,) is dark brown, variegated with paler brown as in the figure, while the spines around the edges are transparent and white.

THE PICKLE WORM—*Phacellura nitidalis*, Cramer.

(Lepidoptera, Margarodidæ.)

As long ago as the year 1828, Dr. T. W. Harris described and named the common Squash Borer (*Ægeria* [*Trochilium*] *cucurbitæ*). This borer is a true caterpillar, having sixteen legs, and very much resembling the common Peach Borer. It is hatched in the early part of summer, from eggs placed by the parent moth on the stems of the vine, close to the root. It penetrates the stem, and by devouring the pith, frequently causes the death of the vine. When full fed it retreats a short distance into the ground and forms a cocoon of a gummy substance covered with particles of earth. Within this cocoon it passes the winter, and early the next summer issues as a moth. This moth is very beautiful, with a conspicuous orange-colored body spotted with black; with the front wings blue-black and with the hind wings perfectly transparent.

Ever since the day when it was first described by Harris, this insect has been known as the Squash Borer. It seems to be confined, however, to a few of the more Eastern States, and although Mr. Wm. Klussman, of Pine Bluff, Arkansas, thinks he is troubled with this species, and has given up the growing of all winter squashes in consequence of its ravages (*Country Gentleman*, Nov. 11, 1869, page 378), yet it certainly is not of common occurrence in the Valley of the Mississippi, or we should more often hear of it.

There is, however, another borer which attacks the roots of cucurbitaceous vines, and which is but too common all over the country. I refer to that ubiquitous little pest the Striped Cucumber-beetle (*Diabrotica vittata*, Fabr.) an insect which annually destroys thousands of dollars' worth of vines in the United States, and for which remedies innumerable—some sensible, but the greater portion not worth the paper on which they are printed—are published every year in our different agricultural papers.

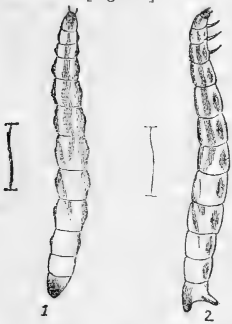
The natural history of this "Striped Bug," as it is more commonly called, was first made known in the West by Dr. Henry Shimer, of Mt. Carroll, in the *Prairie Farmer*, for August 12, 1865. But as everything pertaining to such a very common and destructive insect, cannot be too often repeated, I will here relate its habits in the briefest manner.

[Fig. 39]

The parent beetles (Fig. 39) make their appearance quite early in the season, when they immediately commence their work of destruction. They frequently penetrate through the cracks that are made by the swelling and sprouting of the seeds of melons, cucumbers, or squashes, and by nipping off the young sprouts, destroy the plant before it is even out of the ground.

Their subsequent work when the vines have once pushed forth their leaves, is too well known to need description. Yet notwithstanding the great numbers and the persistency of these beetles, we finally succeed, with the proper perseverance and vigilance, in nursing and protecting our vines, till we think they are large enough to withstand all attacks. Besides, by this time, the beetles actually begin to diminish in numbers, and we congratulate ourselves on our success. But lo! All of a sudden, many of our vines commence to wilt, and they finally die outright. No wound or injury is to be found on the vine above ground, and we are led to examine the roots. Here we soon discover the true cause of death, for the roots are found to be pierced here and there with small holes, and excoriated to such an extent, that they present a corroded appearance. Upon a closer examination the authors of this mischief are easily detected, either imbedded in the root, or lurking in some of the corroded furrows. They are little whitish worms, rather more than a third of an inch long, and as thick as a good sized pin; the head is blackish-brown and horny, and there is a plate of the same color and consistency on the last segment. These worms are in fact the young of the same Striped Bug which had been so troublesome on the leaves earlier in the season; and that the insect may be as well known in this, its masked form, as it is in the beetle state, I present the annexed highly magnified figures of the worm (Fig. 40), No. 1 showing a back view and No. 2 a side view. The beetles, while feasting themselves on the tender leaves of the vine, were also pairing, and these worms hatched from the eggs which were deposited near the roots by the female. When the worms have become full-grown, which is in about a month after they hatch, they forsake the roots and retire into the adjoining earth, where each one, by continually turning around and around, and compacting the earth on all sides forms for itself a little cavity and in a few days throws off its larva skin and becomes a pupa. This pupa is much shorter than was the worm, and is represented enlarged in the annexed Figure 41, No. 1 ventral view, and No. 2 back view, the hair lines at the sides showing the natural size. This pupa state lasts about two weeks, at the end of which time the skin is again moulted, and the perfect beetle form assumed. All the parts of this newly developed beetle are at first soft, but after remaining motionless in its cell, till these soft parts have acquired solidity and strength, it breaks through the walls of its prison and works itself up to the light of day.

[Fig. 40.]



1 2

[Fig. 41.]

1. 2.

There are from two to three generations each year, the number varying according to the latitude, or the length of the winter. To

show however, how the different broods run into one another, and to prove how difficult it is to separate them by distinct lines, I will state that at Kirkwood, Mo., I found this insect abundant in its three stages of larva, pupa, and beetle, during the first days of October last. And in a large jar partly filled with earth, in which I placed a number of infested roots about that time, I to-day (Nov. 8, 1869) find both pupæ and beetles. The soil in this jar was kept as nearly as possible in the same condition as that out of doors, and as I noticed the beetles around the vines even after the first frosts, I am led to infer that, in this latitude at least, the insect often hybernates as a beetle, and not always as a pupa, as intimated by Dr. Shimer.

Of all the multifarious remedies proposed against the attacks of this insect, there are none so effectual or so cheap in the end, as inclosing the young vines in boxes which are open at the bottom, and covered with millinet on the top. Such boxes are made at a trivial cost, and if properly stored away each season after use, will last for many years. Whenever other remedies must from necessity be resorted to, there is nothing better than sprinkling the vines, early in the morning with Paris-green and flour, (one part of the green to four or five of flour) or with white hellebore. It of course follows, that if the beetles are effectually kept off, there will afterwards be no worms at the roots.

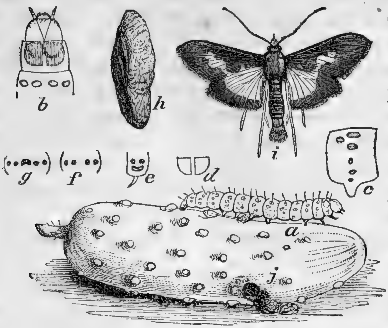
Much complaint was made last summer, in various parts of the country, of the sudden death of cucurbitaceous vines, from some unknown cause, and Henry Ward Beecher seems to have suffered in this manner, like the rest of us, but could find no worms in the roots of his vines. I know from experience that such vines are subject to a species of rot in the root—a rot not caused by insects, and for that reason the more serious, since we cannot tell how to prevent it. I have seen whole melon patches destroyed by this rotting of the roots, but in the great majority of instances where I have examined vines that had died from "some unknown cause," I have had no difficulty in either finding the worms of the "Striped Bug" yet at work on the roots, or else the unmistakable marks of their having been there. Indeed, by the time a vine dies from the effects of their gnawings and burrowings, the worms have generally become fully grown, and have hidden themselves in their little pupal cavities.

So much for the two borers which have heretofore been known to attack plants belonging to the Gourd family. We have seen how they both bore into the roots of these plants, and how one of them in the perfect state attacks the leaves. No other borers have been known to attack these plants, though the 12-Spotted Diabrotica (*D. 12-punctata*, Fig. 42), may often be found embedded in the rind of both melons, cucumbers and squashes. But we now come to a third insect which attacks plants of this same Gourd family. It neither bores into the root, nor devours the foliage, however, but seems to confine itself to the fruit; and I have

[Fig. 42]

called it the Pickle Worm, from the fact of its often being found in cucumbers that have been pickled.

[Fig. 43]



At Figure 43, *a*, I represent one of these worms of the natual size. They vary much in appearance, some being of a yellowish-white, and very much resembling the inside of an unripe melon, while others are tinged more or less with green. They are all quite soft and translucent, and there is a transverse row of eight shiny, slightly elevated spots on each segment, and an additional two behind the others on the back. (See Fig. 43, *c*.) Along the back and towards the head, these spots are larger than at the sides, and each spot gives rise to a fine hair. The specimen from which I obtained my first moth last summer was very light colored, and these spots were so nearly the color of the body as to be scarcely visible. The head was honey-yellow bordered with a brown line and with three black confluent spots at the palpi.

The cervical shield or horny plate on the first segment was of the same color as the body, and so transparent that the brown border of the head when retracted shone distinctly through it as at Figure 43, *b*. The breathing-holes or stigmata are small, oval, and of the same color as the body, with a fulvous ring around them. In some of the young worms the shiny spots are quite black and conspicuous. My late associate, Mr. Walsh, communicated to me the following description of such a marked specimen, from which he bred the very same species of moth as from the paler individuals: The description was taken when the worm was but half grown.

Length ½ inch. Color pale greenish-yellow; 16 legs. Head pale rufous, the Y-shaped sutures and the mouth black. Cervical shield as in Figure 43, *d*, each half edged with black, center rufous. Marked under shield on each side as at *e*, and the same lateral marking on joints, 2 and 3. Above on joints 2 and 3 as at *f*. On joints 4–11, eight (including 2 lateral) spots transversely arranged, and behind these, two dorsal spots. Of the eight spots the two lateral ones on each side are substigmatal. Stigmata edged with dusky. Anal joint with five spots as in *g*, the middle one large and transverse. Body with some sparse long dusky hairs, 6–8 times as long as wide, a little tapered toward the head. Spins a thread. Legs and prolegs nearly immaculate.

The worms commenced to appear in the latitude of St. Louis, about the middle of July, and they continued their destructive work till the end of September. They bore cylindrical holes into the fruit and feed on its fleshy parts. They are gross feeders and produce a

large amount of soft excrement. I have found as many as four in a medium-sized cucumber, and a single worm will often cause the fruit to rot. They develop very rapidly and come to their growth in from three to four weeks. When about to transform they forsake the fruit in which they had burrowed, and drawing together portions of some leaf that lies on or near the ground, spin a slight cocoon of white silk. Within this cocoon they soon become slender brown chrysalids with the head parts prolonged, and with a very long ventral sheath which encloses the legs. If it is not too late in the season the moths issue in from eight to ten days afterwards. The late individuals, however, pass the winter within their cocoons; though, from the fact that some moths come out as late as November, I infer that they may also winter over in the moth state.

The moth produced by this worm (of which Figure 43, *i*, represents the male) is very strikingly marked. It is of a yellowish-brown color, with an iris-purple reflection, the front wings having an irregular, semi-transparent, dull golden-yellow spot, not reaching their front edge, and constricted at their lower edge; and the hind wings having their inner two-thirds of this same semi-transparent yellow. The under surfaces have a more decided pearly lustre. The thighs, the breast, and the abdomen below, are all of a beautiful silvery-white, and the other joints of the long legs are of the same tawny or golden-yellow as the semi-transparent parts of the wings. The abdomen of the female terminates in a small flattened black brush, squarely trimmed, and the segment directly preceding this brush is of a rust-brown color above. The corresponding segment in the male is, on the contrary, whitish anteriorly and of the same color as the rest of the body posteriorly, and he is, moreover, at once distinguished from the female, by the immense brush at his tail, which is generally much larger than represented in the above figure, and is composed of narrow, lengthened (*ligulate*) scales, which remind one of the petals of the common English daisy, some of these scales being whitish, some orange, and others brown. This moth was described nearly a century ago by Cramer, under the scientific name of *Phak*[*c*]*ellura nitidalis*, and it may be known in English as the Neat Cucumber Moth. The genus to which it belongs is characterized chiefly by the partly transparent wings, and by the immense scaly brush of the males. The antennæ are long, fine and thread-like, those of the male being very finely ciliated; the abdomen extends beyond the wings, and the legs are very long and slender. The species are for the most part exotic, and the larvæ of all of them, so far as known, feed on cucurbitaceous plants.

The following item, taken from a St. Louis paper, though somewhat facetious, will give an idea of the extent of the injuries caused by this insect in that vicinity:

What's the matter with the cucumbers? A lady of our acquaintance, the other day, sent to market to purchase some cucumbers for

pickling purposes. They were placed in a vessel to be washed, previous to being put in the brine. It was then observed that small, singular looking worms clung in the 'wrinkles' on the outside of some of the cucumbers. These were washed off, when accident led to the discovery that inside every one of the cucumbers was secreted a white, corrugated, creeping thing, from half an inch to over an inch in length, resembling in miniature a rattlesnake's rattles, and not a very pretty object to look upon. It turns out that nearly, if not all the cucumbers brought to this market this season are affected the same way. These worms certainly do not look very good to eat, in the unpickled form; but we are told that they are entirely harmless in the natural state, and probably add to the pungency and crispness of the gherkin when forming part of the chow-chow, and other relishes which grace every well regulated square meal. Like the mites in the cheese, which with some are supposed to testify to the good quality and healthfulness of the article, we suppose worms in the pickles may fairly be considered a question of taste; but, if it is not obtrusive, we will add that we do not believe they are to *our* taste or digestion, and, if it is all the same to the cucumber merchants, we would rather not take any in our'n.

In Missouri, I have myself found this insect quite abundant in various parts of St. Louis and Jefferson counties, and the cucumbers seem to have fared worse than the melons. That it was not confined to these two counties, is also proved by the following communication which appeared in the *Journal of Agriculture*, of September 10, 1869:

Pleasant Hill, Mo., September 2, 1869. — Last winter, seeing many glowing accounts of the "Alton Large Nutmeg Melon," I sent to Mr. Barler and procured some, paying thirty cents an ounce for them; planted and worked well; during August, had some melons. The first few tasted right well, but soon my "Green Citron" cantelope ripening, the difference in the taste of the two was found to be so great that we could not eat the Alton Nutmeg. Furthermore, the latter had worms in them—the larvæ of some insect—eating into nearly every one. The Green Citron was rarely attacked by them. I have raised this variety of Green Citron for several years, and would not give one of the melons for a dozen Alton Nutmegs. It is sweet, juicy and very rich in taste. When a boy, I can remember a cantelope that was raised by my father, called "Persian." I think the Green Citron probably derived from it.

Yours, G. C. Broadhead.

In Illinois, it was very destructive around Alton, during the month of August; for, on July 19th, I received specimens from G. W. Copley, of that place, and found (Sept. 2, 1869), on visiting Mr. O. L. Barler's large melon fields, that fully three-fourths of his melons had been injured by it. Since then, several other Alton men have assured me that it was equally destructive with them. It also occurred around Springfield, for Mr. P. M. Springer sent to me, the last of October, a specimen of the moth which he had bred from a cucumber-boring worm; while Mr. Walsh also found it abundant at Rock Island, in the northern part of that State.

In Michigan, as I learned from Mr. W. B. Ransom, of St. Joseph,

it greatly injured the cucumbers and melons around that place; and Mr. Glover, of the Department of Agriculture, informs me that he has found the worm on Squash, in Florida, in July. Thus it appears that this Pickle Worm has a wide range, and that last summer it simultaneously fell upon the cucumbers and melons in widely different parts of the country. Of course, in making pickles, the worm is pickled with the cucumber, and we shall consequently continue to hear startling stories about the worms in the pickles.

This insect, so far as I can ascertain, has never before been figured or described in this country; nor can I find any mention made of its destructive work in past years. I am, therefore, led to the conclusion that it was never numerous or destructive enough in the past, to attract attention. This fact becomes the more astonishing, when we consider how wide-spread and general its injuries were the past summer; and it furnishes another illustration of the sudden and enormous increase, in some particular year, of an insect which had scarcely ever before been noticed.

The system of Nature is so complicated, and every animal organism is subject to so many influences that affect its increase or decrease, that we are not surprised at the fluctuation in the relative numbers of any particular species. The "Struggle for Life," as expounded by Darwin, is no where more effectual in bringing about changes than in insect life. We are at first a little puzzled to account for the sudden advent, and the equally sudden departure of such insects as the Army-worm, Chinch Bug, Wheat Midge, etc., but when we once acquire a just conception of the tangled web in which every insect is involved, we wonder rather that the balance is so well kept.

Our Pickle-worm is an indigenous species, and has, doubtless, existed in some part or other of the country from time immemorial; and now that its habits are recorded and its history made known, I should not be at all surprised to learn that individuals have suffered from it in years gone by. The French Entomologist, Guenée, gives as its food-plant, a species of potato, and it is just possible that it may not always have fed upon the same plants on which it was found last summer. At all events, let us hope that it will disappear as suddenly as it appeared; but should it occur in great numbers again next year, the foregoing account will enable those who grow melons, cucumbers or squashes, to understand their enemy, and to nip the evil in the bud, by carefully overhauling their vines early in the summer, and destroying the first worms that appear, either by feeding the infested fruit to hogs or cattle, or by killing the worms on the spot. I know from experience that this worm when pickled with the cucumber, does not in the least affect its taste, and is not in the least injurious to the human system; but as it is not very desirable food, pickles should always be halved, before being brought to the table, especially if they were gathered from a field or garden known to be infested.

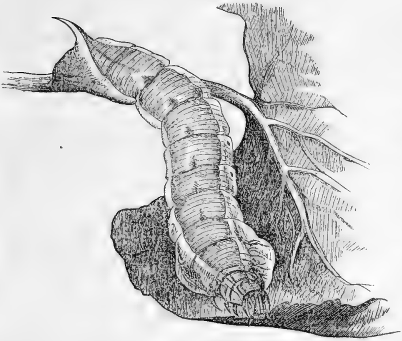
INSECTS INJURIOUS TO THE GRAPE-VINE.

Under this head, I shall continue the series of articles begun in my First Report, in order to give the grape-growers of our State a thorough understanding of their insect enemies, and thus lessen the hindrances and drawbacks to viticulture—that most important and pleasant part of rural industry, which is increasing with such unprecedented rapidity.

THE HOG-CATERPILLAR OF THE VINE—*Chœrocampa pampinatrix*, Sm. & Abb.*

[Lepidoptera, Sphingidæ.]

[Fig. 44.]



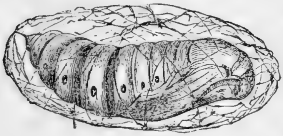
Of the large solitary caterpillars that attack the Grape-vine, this is by far the most common and injurious in the Mississippi Valley. I have frequently found the egg of this insect glued singly to the underside of a leaf. It is 0.05 inch in diameter, perfectly round and of a uniform delicate yellowish-green color. The young worm which hatches from it, is pale green, with a long straight horn at its tail; and after feeding from four to five weeks it acquires its full growth, when it presents the appearance of Figure 44, the horn having become comparatively shorter and acquired a posterior curve.

This worm is readily distinguished from other grape-feeding species by having the third and fourth rings immensely swollen, while the first and second rings are quite small and retractile. It is from this peculiar appearance of the fore part of the body, which strikingly suggests the fat cheeks and shoulders and small head of a blooded hog, that it may best be known as the Hog-caterpillar of the vine. The color of this worm when full grown is pea-green, and it is wrinkled transversely and covered with numerous pale-yellow dots, placed

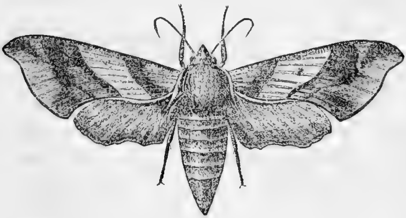
*Synonyms, *Sphinx*, [*Darapsa*] *myron*, Cramer; *Otus cnotus*, Huebner. Of the four different generic names under which this species has been classified, "*Sphinx*" is a general term for all the Hawk-moths and refers to the sphinx-like attitude often assumed by their larvæ; "*Chœrocampa*" is derived from two Greek words which mean "Hog-caterpillar;" and "*Darapsa*" and "*Otus*" are gibberish. Of the three different specific names, "*Myron*" refers to an ancient Greek who bore this appellation, "*cnotus*" is pure unadulterated gibberish, and "*pampinatrix*" is from the Latin and signifies "a female vine-pruner." Both Harris and Fitch describe this insect under the name of *Chœrocampa pampinatrix*; and this, as the appellation best known to our grape-growers, and the most characteristic of the habits of the species, I should prefer to retain, although no doubt, according to the strict Law of Priority, the specific name of *Myron* ought to be employed. Mr. Walker, Dr. Clemens and Dr. Morris call this species "*Darapsa Myron*," and Mr. Grote calls it "*Otus Myron*." By ringing the changes with sufficient ingenuity upon the four generic and the three specific names, we may obtain no less than twelve different names for this one insect!

in irregular transverse rows. An oblique cream-colored lateral band, bordered below with a darker green, and most distinct on the middle segments, connects with a cream-colored subdorsal line, which is bordered above with darker green, and which extends from the head to the horn at the tail. There are five and often six somewhat pale yellow triangular patches along the back, each containing a lozenge-shaped lilac-colored spot. The head is small, with yellow granulations, and four perpendicular yellow lines, and the spiracles or breathing holes are orange-brown. When about to transform, the color of this worm usually changes to a pinkish-brown, the darker parts being of a beautiful mixture of crimson and brown. Previous to this change of color Mr. J. A. Lintner, of Schoharie, New York, has observed the worm to pass its mouth over the entire surface of its body, even to the tip of its horn, covering it with a coating of apparently glutinous matter—the operation lasting about two hours.* Before transforming into the pupa or chrysalis state, it descends from the vine, and within some fallen leaf or under any other rubbish that may be lying on the ground, forms a mesh of strong brown silk, within which it soon changes to a chrysalis (Fig. 45.) of a pale, warm yellow, speckled and spotted with brown, but characterized chiefly by the conspicuous dark brown spiracles and broad brown incisures of the three larger abdominal segments.

[Fig. 45.]



[Fig. 46.]



The moth (Fig. 46) which in time bursts from this chrysalis, has the body and front wings of a fleshy-gray, marked and shaded with olive-green as in the figure, while the hind wings are of a deep rust color, with a small shade of gray near their inner angle.

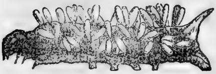
This insect is, in northerly regions, one-brooded, but towards the south two-brooded, the first worms appearing, in the latitude of St. Louis, during June and July, and giving out the moths about two weeks after they become chrysalids, or from the middle of July to the first of August. The worms of the second brood are full grown in September, and passing the winter in the chrysalis state, give out the moths the following May. On one occasion I found at South Pass, Illinois, a worm but one-half grown and still feeding as late as October 20th, a circumstance which would lead to the belief that at

*Proc. Ent. Soc.. Phil., III, p. 663.

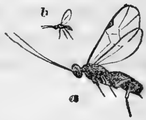
points where the winters are mild, they may even hybernate in the larva state.

This worm is a most voracious feeder, and a single one will sometimes strip a small vine of its leaves in a few nights. According to Harris it does not even confine its attacks to the leaves, but in its progress from leaf to leaf, stops at every cluster of fruit, and either from stupidity or disappointment, nips off the stalks of the half-grown grapes and allows them to fall to the ground untasted. It is fortunate for the grape-grower, therefore, that Nature has furnished the ready means to prevent its ever becoming excessively numerous, for I have never known it to swarm in very great numbers. The obvious reason is, that it is so freely attacked by a small parasitic Ichneumon fly—belonging to a genus (*Microgaster*) exceedingly numerous in species—that three out of every four worms that we meet with will generally be found to be thus victimized. The eggs of the parasite are deposited within the body of the worm, while it is yet young, and the young maggots hatching from them feed on the fatty parts of their victim. After the last moult of a worm that has been thus attacked, numerous little heads may be seen gradually pushing through different parts of its body; and as soon as they have worked themselves so far out that they are held only by the last joint of the body, they commence forming their small snow-white cocoons, which stand on ends and present the appearance of Figure 47. In about a week the fly (Fig. 48, *a*, magnified; *b*, natural size) pushes open a little lid which it had previously cut with its jaws, and soars away to fulfil its mission. It is one of those remarkable and not easily explained facts, which often confront the student of Nature, that, while one of these Hog-caterpillars in its normal and healthy condition may be starved to death in two or three days, another, that is writhing with its body full of parasites will live without food for as many weeks. Indeed, I have known one to rest for three weeks without food in a semi-paralyzed condition, and after the parasitic flies had all escaped from their cocoons, it would rouse itself and make a desperate effort to regain strength by nibbling at a leaf which was offered to it. But all worms thus attacked succumb in the end, and I cannot conclude this article to better advantage than by reminding the Grape-grower, that he should let alone all such as are found to be covered with the white cocoons above illustrated, and not, as has been often done, destroy them under the false impression that the cocoons are the eggs of the worm. Numbers of these little white cocoons are sent to me every year under the supposition that they are eggs, and no doubt many of them get destroyed by the very persons who ought to cherish them.

[Fig. 47.]



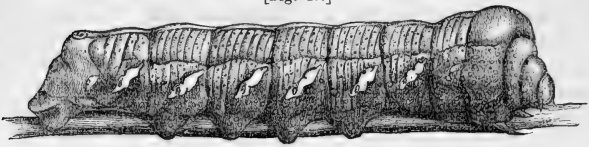
[Fig. 48.]



THE ACHEMON SPHINX—*Philampelus achemon*, Drury.*

(Lepidoptera, Sphingidæ.)

[Fig. 49.]



a

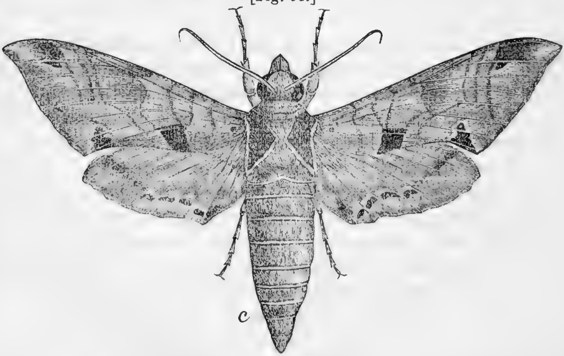
This is another of the large Grape-vine-feeding insects, belonging to the great *Sphinx* family, and which may be popularly known as the Achemon Sphinx. It has been found in almost every State where the Grape is cultivated, and also occurs in Canada. It feeds on the American Ivy (*Ampelopsis quinquefolia*, with as much relish as on the Grape-vine, and seems to show no preference for any of the different varieties of the latter. It is, however, worthy of remark, that both its food-plants belong to the same botanical Family.

[Fig. 50.]

b

The full grown larva (Fig. 49.) is usually found during the latter part of August and fore part of September. It measures about 3½ inches when crawling, which operation is effected by a series of sudden jerks. The third segment is the largest, the second but half its size and the first still smaller, and when at rest the two last mentioned segments are partly withdrawn into the third as shown in the figure. The young larva is green, with a long slender reddish horn rising from the eleventh segment and curving over the back, and

[Fig. 51.]



c

*The synonyms for this insect are *Sphinx Crantor*, Cramer, and *Pholus crantor*, Huebner. The genus *Philampelus*—meaning literally "fond of the vine"—was erected by Harris to include this and the next species.

though I have found full grown specimens that were equally as green as the younger ones, they more generally assume a pale straw or reddish-brown color, and the long recurved horn is invariably replaced by a highly polished lenticular tubercle. The descriptions extant of this worm are quite brief and incomplete. The specimen from which my drawing was made, was of a pale straw color which deepened at the sides and finally merged into a rich vandyke-brown. A line of a *feuille-morte* brown, deep and distinct on the anterior part, but indistinct and almost effaced on the posterior part of each segment, ran along the back, and another line of the same color, continuous, and with its upper edge fading gradually, extended along each side. The six scalloped spots were cream-colored; the head, thoracic segments and breathing-holes inclined to flesh-color, and the prolegs and caudal plate were deep brown. The worm is covered more or less with minute spots which are dark on the back but light and annulated at the sides, while there are from six to eight transverse wrinkles on all but the thoracic and caudal segments.

The color of the worm, when about to transform, is often of a most beautiful pink or crimson. The chrysalis (Fig. 50) is formed within a smooth cavity under ground. It is of a dark shiny mahogany-brown color, shagreened or roughened, especially at the anterior edge of the segments on the back.

Unlike the Hog-caterpillar of the Vine, just described, this insect is everywhere single-brooded, the chrysalis remaining in the ground through the fall, winter and spring months, and producing the moth towards the latter part of June. I rather incline to believe however that there may be exceptions to the rule in southerly latitudes, and that in such latitudes it may sometimes be double-brooded; for I have known the moth to issue near St. Louis during the first days of August, and have this very year found two worms in the same locality as late as the 25th of October, neither of which was quite full grown, though the leaves on the vines upon which they were found had almost all fallen. Apparently such premature development of *Sphinx* moths is a well-known occurrence among the different European species; for Chas. Darwin remarks that "a number of moths, especially *Sphinx* moths, when hatched in the autumn out of their proper season, are completely barren; though the fact of their barrenness is still involved in some obscurity.*

The moth (Fig. 51), is of a brown-gray color variegated with light brown, and with the dark spots, shown in the figure, deep brown. The hind wings are pink with a dark shade across the middle, still darker spots below this shade, and a broad gray border behind. I once had an excellent opportunity of observing how it burst open the chrysalis shell, for while examining a chrysalis, the moth emerged. By a few sudden jerks of the head, but more especially by friction

*See *Variation of Animals and Plants, etc.*, II, pp. 157–8, English Edition, and the references there given in the foot-note.

with the knees of the middle pair of legs, it severed and ruptured the thin chrysalis shell, and the very moment the anus touched the ruptured end, the creamy fluid usually voided by newly-hatched moths was discharged.

I have never found any parasite attacking this species, but its solitary habit and large size make it a conspicuous object, and it is easily controlled by hand, whenever it becomes unduly numerous upon the Grape-vine.

THE SATELLITE SPHINX—*Philampelus satellitia*, Linn.*

(Lepidoptera Sphingidæ.)

Like the preceding insect this one occurs in almost every State in the Union. It also bears a strong resemblance to the Achemon Sphinx, and likewise feeds upon the *Ampelopsis* as well as upon the Grape-vine; but the worm may readily be distinguished from the former by having five cream-colored spots each side, instead of six, and by the spots themselves being less scalloped.

[Fig. 52.]

In the latitude of St. Louis, this worm is found full grown throughout the month of September, and a few specimens may even be found as late as the last of October. The eggs of this species, as of all other Hawk-moths (*Sphinx* family) known to me, are glued singly to the leaf of the plant which is to furnish the future worm with food. When first hatched, and for sometime afterwards, the larva is green, with a tinge of pink along the sides, and with an immensely long straight pink horn at the tail. This horn soon begins to shorten, and finally

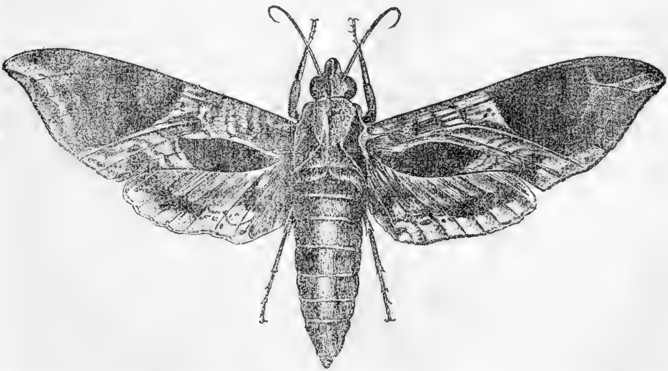
*The synonyms for this insect are *Sphinx lycaon*, Cramer; *Pholus lycaon*, Huebner, and *Daphni pandorus*, Huebner. Mr. A. Grote (Proc. Ent. Soc. Phil., I, p. 60), believes that the *Sphinx lycaon* of the authors above quoted, is distinct from *S. Satellitia*, Linn., and would fain "*eliminate*" a third species (*posticatus*). For reasons which it would be tedious to give here, I prefer to regard *lycaon* as a variety of *satellitia*.

curls round like a dog's tail, as at Figure 52, *c*. As the worm grows older it changes to a reddish-brown, and by the third moult it entirely loses the caudal horn.

When full grown, it measures nearly four inches in length, and when crawling, appears as at Figure 52, *a*. It crawls by a series of sudden jerks, and will often fling its head savagely from side to side when alarmed. Dr. Morris* describes the mature larva as being green, with six side patches; but though I have happened across many specimens of this worm during the last seven years, I never once found one that was green after the third moult; nor do I believe that there are ever any more than five full-sized yellow spots each side, even in the young individuals. The specimen from which the above figure was made, occurred in 1867, at Hermann, Missouri, in Mr. Geo. Husmann's vineyard. The back was pinkish, inclining to flesh-color; the sides gradually became darker and darker, and the five patches on segments 6—10 inclusive, were cream-yellow with a black annulation, and shaped as in the figure. On segments 2, 3, 4, 5 and 6, were numerous small black dots, but on each of the following five segments there were but two such dots. A pale longitudinal line ran above the yellow patches, and the head and first joint were uniformly dull reddish-brown.

The most common general color of the full-grown worm is a rich velvety vinous-brown. When at rest, it draws back the fore part of the body, and retracts the head and first two joints into the third (see Fig. 52, *b*), and in this motionless position it no doubt manages to

[Fig. 53.]



escape from the clutches of many a hungry insectivorous bird. Dr. Morris, copying perhaps after Harris, erroneously states that the three anterior joints, together with the head, are retracted into the *fourth*, and Mr. J. A. Lintner† makes the same false assertion. It is

*Synopsis of N. A. *Lepidoptera*, p. 178.
†Proc. Ent. Soc. Phil., III, p. 659.

the *third* segment in this species, as well as in the Achemon Sphinx, which is so much swollen, and into which the head and first two segments are retracted.

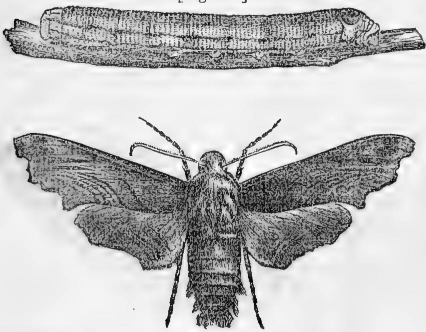
When about to transform, the larva of our Satellite Sphinx enters a short distance into the ground, and soon works off its caterpillar-skin and becomes a chrysalis of a deep chestnut-brown, and very much of the same form as that of the Achemon Sphinx, figured on page 74. The moth (Fig. 53), makes its appearance in June of the following year, though it has been known to issue the same year that it had existed as larva. In this last event, it doubtless becomes barren, like others under similar circumstances, as was shown on page 75. The colors of the moth are light olive-gray, variegated as in the figure with dark olive-green. The worms are easily subdued by hand-picking.

THE ABBOT SPHINX—*Thyreus Abbotii*, Swainson.

(Lepidoptera, Sphingidæ.)

This is another of the large Grape-feeding insects, occurring on the cultivated and indigenous vines and on the Virginia Creeper, and having in the full-grown larva state, a polished tubercle instead of a horn at the tail. Its habitat is given by Dr. Clemens, as New York, Pennsylvania, Georgia, Massachusetts, and Ohio; but though not so common as the Sphinx moths previously described, yet it is often met with both in Illinois and Missouri. The larva which is represented in the upper part of Figure 54, varies considerably in appearance. Indeed, the ground-color seems to depend in a measure on the sex, for Dr. Morris describes this larva as reddish-brown with numerous patches of light-green, and expressly states that the *female* is of a uniform reddish-brown, with an interrupted dark brown dorsal line and transverse striæ. I have reared two individuals which came to their growth about the last of July, at which time they were both without a vestige of green. The ground-color was dirty yellowish, especially at the sides. Each segment was marked transversely with six or seven slightly impressed fine black lines, and longitudinally with wider

[Fig. 54.]



non-impressed dark brown patches, alternating with each other, and giving the worm a checkered appearance. These patches become more dense along the subdorsal region, where they form two irregular dark lines, which on the thoracic segments become single, with a similar line between them. There was also a dark stigmatal line with a lighter shade above it, and a dark stripe running obliquely downwards from the posterior to the anterior portion of each segment. The belly was yellow, with a tinge of pink between the prolegs, and the shiny tubercle at the tail was black, with a yellowish ring around the base. The head, which is characteristically marked, and by which this worm can always be distinguished from its allies—no matter what the ground-color of the body may be—is slightly roughened and dark, with a lighter broad band each side, and a central mark down the middle which often takes the form of an x. This worm does not assume the common Sphinx attitude of holding up the head, but rests stretched at full length, though if disturbed it will throw its head from side to side, thereby producing a crepitating noise.

The chrysalis is formed in a superficial cell on the ground; its surface is black and roughened by confluent punctures, but between the joints it is smooth and inclines to brown; the head-case is broad and rounded, and the tongue-case is level with the breast; the tail terminates in a rough flattened wedge-shaped point, which gives out two extremely small thorns from the end.

The moth (Fig. 54, below) appears in the following March or April, there being but one brood each year. It is of a dull chocolate or grayish-brown color, the front wings becoming lighter beyond the middle, and being variegated with dark brown as in the figure; the hind wings are sulphur-yellow, with a broad dark brown border breaking into a series of short lines on a flesh-colored ground, near the body. The wings are deeply scalloped, especially the front ones, and the body is furnished with lateral tufts. When at rest, the abdomen is curiously curved up in the air.

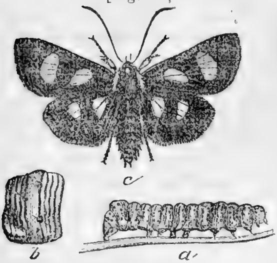
THE BLUE CATERPILLARS OF THE VINE.

Besides these large Sphinx caterpillars, every grape-grower must have observed certain so-called "Blue Caterpillars," which, though far from being uncommon, are yet very rarely sufficiently numerous to cause alarm, though in some few cases they have been known to strip certain vines. There are three distinct species of these blue caterpillars, which bear a sufficiently close resemblance to one another, to cause them to be easily confounded. The first and by far the most common with us is the larva of

THE EIGHT-SPOTTED FORESTER—*Alypia octomaculata*, Fabr.

(Lepidoptera, Zygænidæ.)

[Fig. 55.]



At Plate I, Figure 18 of my First Report, the male of this moth is illustrated by the side of its supposed larva, Figure 19 of the same Plate. In the text (pp. 136–7) I expressed some doubts as to whether this last was the rightful larva of the Eight-spotted Forester, and as I have since reared several moths from the larva state, and ascertained that the worm there figured does not belong to the Eight-spotted Forester, but in all probability to the Pearl Wood Nymph, I will now give the characters of these three different blue caterpillars, so that they may readily be distinguished hereafter.

The larva of the Eight-spotted Forester may often be found in the latitude of St. Louis as early as the beginning of May, and more abundantly in June, while scattering individuals (probably of a second brood) are even met with, but half-grown, in the month of September. The young larvæ are whitish with brown transverse lines, the colors not contrasting so strongly as in the full-grown specimens, though the black spots are more conspicuous. They feed beneath the leaves and can let themselves down by a web. The full-grown larva often conceals itself within a folded leaf. It is of the form of Figure 55, *a*, and is marked transversely with white and black lines, each segment having about eight light and eight dark ones. The bluish appearance of this caterpillar is owing to an optical phenomenon from the contrast of these white and black stripes. The head and the shield on the first segment are of a shiny bright deep orange color, marked with black dots, and there is a prominent transverse orange-red band, faint on segments 2 and 3; conspicuous on 4 and 11 and uniform in the middle of each of the other segments. In the middle segments of the body each orange band contains eight black conical elevated spots or tubercles, each spot giving rise to a white hair. These spots are arranged as in the enlarged section shown in the engraving (Fig. 55, *b*), namely, four on each side as follows: the upper one on the anterior border of the orange band, the second on its posterior border, the third just above spiracles on its anterior border—each of the three interrupting one of the transverse black lines —and the fourth, which is smaller, just behind the spiracles. The venter is black, slightly variegated with bluish-white, and with the orange band extending on the legless segments. The legs are black, and the false-legs have two black spots on an orange ground, at their outer base; but the characteristic feature, which especially distinguishes it from the other two species, is a lateral white wavy band—

obsolete on the thoracic segments, and most conspicuous on 10 and 11—running just below the spiracles, and interrupted by the transverse orange band.

I quote here Harris's full description of this larva (*Correspondence*, p. 286), as it agrees with mine, except in giving the number of transverse black lines as 6 on each segment, instead of 8, from the fact that he does not include the two which border the orange band, on account of their being interrupted. I have preferred to consider each segment of this worm as 8-banded, to distinguish it more readily from the other two species, which have respectively only six and four. "Length, when at rest, one inch and two-tenths, very pale blue, transversely banded with orange on the middle of each segment, the bands dotted with small black points, producing hairs, and surmounted by black lines, and between each of the bands six transverse black lines. A large, irregular, white spot on the side of the tenth and eleventh segments, and a series of smaller white spots on each of the other segments except the first three. Head orange dotted with black. Legs blackish externally. The full-grown, have a decidedly bluish tinge, entirely owing, however, to an optical phenomenon from the contrast of the white with the transverse black lines. The head is of a pale dirty orange or rusty yellow, with about eight black dots on each side; [about 10 large and 14 small dots in all,] a semicircular plate on the top of the first segment and the anal valves are pale orange dotted with black. There is a transverse series of black dots on the second and third segments, without an orange band. Each of the other segments is transversely banded with orange and dotted with black; the dots being in two alternate rows, and all of them emitting distinct, long whitish hairs. [The anterior dots on the back of segments 4, 5 and 6 and the posterior ones on 11, are considerably larger than the rest]. Between each of the bands there are six slender, continuous, black transverse lines. The points are also connected by interrupted black lines. Legs at base orange, black externally and at tip, except the anal pair which are orange, dotted with black. The large white lateral spot is common to the side of the tenth and eleventh segments. The other lateral white spots are situated immediately behind the bands on the fourth, fifth, sixth, seventh, eighth and ninth segments, the anterior spots being largest; and thence they diminish to the ninth, while again the posterior spot is very large and very distinct. The orange bands are interrupted on the top of the seventh, eighth and ninth segments."

This larva transforms to chysalis within a very slight cocoon formed without silk, upon, or just below the surface of the earth, and issues soon after, as a very beautiful moth of a deep blue-black color, with orange shanks, yellow shoulder-pieces, each of the front wings with two large light yellow spots, and each of the hind wings with two white ones. The illustration (Fig. 55, *c*) represents the female, and the male differs from her in having the wing spots larger, and in having a conspicuous white mark along the top of his narrower abdomen.

I have on one or two occasions known vines to be partly defoliated by this species, but never knew it to be quite so destructive as it is represented in the following communication from Mr. W. V. Andrews, of New York city, which I take from the February (1869) nummer of the *American Naturalist*:

"That a man should desire to raise his own Isabellas is laudable and praiseworthy; and I see no reason why such desire should exist exclusively in the breasts of our bucolic friends. The inhabitants of New York, as a general thing, clearly are of the same opinion, as is evidenced by the number of grape-vines ornamenting the doors and trellis-work of the houses of our citizens; not, of course, in the benighted regions of Wall street, but up-town; say from Sixteenth street northward. A friend of mine residing on Thirty-fourth street, showed me, in March last, a very fine vine, which he calculated would produce him sundry pounds of choice grapes, and in the pride of his

heart he invited me to "call along" occasionally, and feast my eyes on the gradual development of the incipient bunches. Thinking that August would be a good month for my visit, I "called along," wondering in my mind whether my friend would, when the time of ripe grapes came, desire me to help myself out of his abundance; or whether he intended to surprise me with a little basket of nice bunches, garnished with crisp, green leaves. The first glance at the grape-vine banished all doubts on this point. There were an abundance of bunches on the vine, in a rather immature condition, of course, but of foliage there was not a trace. Of course I expressed my surprise, though, for certain reasons, I felt none; and asked my friend why he selected a species of vine for shelter, ornament, and use, which produced no foliage. He rebuked my ignorance pretty sharply, and told me that a few weeks before, the vine was covered with leaves; but, for some inexplicable reason, they had all disappeared—eaten, he guessed, by something. He guessed right. There were at least a hundred of the larvæ of *A*, *octomaculata*, the rear guard of a mighty host, wandering about the branches, apparently for the purpose of making sure that no little particle of a leaf was left undevoured. Pretty little things they were, with harmoniously blended colors of black, yellow and blue, but so terribly destructive! I had the curiosity to walk through all the streets to the east of Third avenue, as low as Twenty-third street, and every vine was in the same predicament. If grape leaves, instead of fig leaves, had been in request for making aprons, and one *Alypia* had been in existence at the time, I doubt if in the whole Garden of Eden enough material would have been found to make a garment of decent size. The destruction of the crop for 1868 was complete.

"This was bad. But it was not half so bad as the helpless ignorance which possessed nearly all of the unfortunate owners of vines. Scarcely one that I conversed with had the remotest idea of the cause of the disaster, and when I explained that it was the caterpillar of a beautiful little black moth, with eight whitish-yellow spots on its wings, which had eaten up the foliage, my assertion was received with such a smile of incredulity, as convinced me that there is no use in trying to humbug such very sharp fellows as are the New York grape-growers.

"It is a little remarkable, however, that the destruction was confined to the eastern part of the city. I saw several luxuriant vines on the western side; and across the river at Hoboken, and at Hudson City, not a trace of *A. octomaculata* was discernible.

"The insect, then, is very local in its habits, and it is a day-flyer; and, from these facts, I infer that its ravages may be very materially checked. A little poisoned molasses, exposed in the neighborhood of the vine, would operate on the perfect insect [extremely doubtful]; while a good syringing with *soft soap* and water would bring down the caterpillars effectually."

THE BEAUTIFUL WOOD NYMPH—*Eudryas grata*, Fabr.

(Lepidoptera, Zygænidæ.)

Here is another moth (Fig. 56), surpassing in real beauty, though not in high contrast, the species just described. The front wings are milk-white, broadly bordered and marked, as in the figure, with rusty-brown, the band on the outer margin being shaded on the inner side with olive-green, and marked towards the edge with a slender wavy white line: under surface yellow, with two dusky spots near the middle. The hind wings are nankin-yellow, with a deep brown border, which does not extend to the outer angle, and which also contains a wavy white line: under surface yellow with a single black spot.

[Fig. 56.]

Surely these two moths are as unlike in general appearance as two moths well can be; and yet their caterpillars bear such a close resemblance to each other, and both feed upon the Grape-vine! The larva of the Beautiful Wood Nymph is, in fact, so very similar to that of the Eight-spotted Forester, that it is entirely unnecessary to figure it. It differs more especially from that species by invariably lacking the white patches along the sides, by the hairs arising from the black spots being less conspicuous, and by the hump on the eleventh segment being more prominent. The light parts of the body have really a slight bluish tint, and in specimens which I have found, I have only noticed six transverse black stripes to each segment. This larva, when at rest, depresses the head and raises the third and fourth segments, Sphinx-fashion. It is found on the vines in the central portion of the State as early as May and as late as September, and it devours all portions of the leaf, even to the midrid. It descends to the ground, and without making any cocoon, transforms to a chrysalis, which is dark colored, rough, with the tip of the abdomen obtusely conical, ending in four tubercles, the pair above, long and truncate, those below broad and short (Packard). Some of them give out the moth the same summer, but most of them pass the winter and do not issue as moths till the following spring.

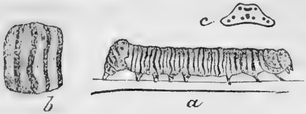
THE PEARL WOOD NYMPH—*Eudryas unio*, Huebner.

(Lepidoptera, Zygænidæ.)

This is another pretty little moth, so closely allied to, and so much resembling the preceding species, that it is not necessary to produce its picture. It is a smaller species, and differs from the Beautiful Wood Nymph in having the outer border of the front wings paler and of a tawny color, with the inner edge wavy instead of straight;

and in that of the hind wings being less distinct, more double, and extending to the outer angle.

[Fig. 57.]



The larva is said by Dr. Fitch to so much resemble that of the preceding species that "we as yet know not whether there are any marks whereby they can be distinguished from each other." (Report 3, § 124.) The moth is more common with us than its larger ally, and though I have never bred it from the larva, yet I have often met with a worm (Fig 57, *a*,) which there is every reason to believe, belongs to this species, and which is easily recognized from the preceding. It never grows to be quite so large as the other, and may readily be distinguished by its more decided bluish cast; by having but four light and four dark stripes to each segment (Fig. 57, *b*,); by having no orange band across the middle segments, and by the spots, with the exception of two on the back placed in the middle light band, being almost obsolete. The head, shield on the 1st segment, hump on the 11th, and a band on the 12th, are orange, spotted with black, the hump being marked as at Figure 57, *c*. Venter orange, becoming dusky towards head; feet and legs also orange, with blackish extremities, and with spots on their outside at base.

The worm works for the most part in the terminal buds of the vine, drawing the leaves together by a weak silken thread, and cankering them. It forms a simple earthen cocoon, or frequently bores into a piece of old wood, and changes to chrysalis, which averages but 0.36 inch in length; this chrysalis is reddish-brown, covered on the back with rows of very minute teeth, with the tip of the abdomen truncated, and terminating above in a thick blunt spine each side.

From the above accounts it is hoped that the reader will have no difficulty in distinguishing between these three blue caterpillars of the Grape-vine. But, says the practical grape-grower, "what does it concern me to know whether the little blue varmints that are defoliating my vines, belong to this species or to that? All I wish to know is how to get rid of them, and as they are all three so nearly alike, the remedy applied to one must be equally effectual with the others." Gently, dear reader; it *may* prove of considerable importance that you know which particular species infests your vines! If, for instance, a person living in the West should find the larvæ of the Beautiful Wood Nymph, then he need feel no alarm; while if a person living in the East should find that of the Pearl Wood Nymph, he may in like manner put his hands in his pockets and go his way with an easy mind; for neither of these species are likely to become troublesome in those respective sections of the country, since heretofore they have always been quite rare in those parts. Again, the larvæ of the two Wood Nymphs have a fondness for boring into old pieces of wood, to transform to the chrysalis state, and Mr. T. B. Ashton, of White Creek,

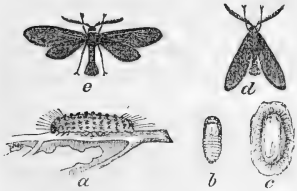
New York, found that they would even bore into corn cobs for this purpose in preference to entering the ground, wherever such cobs were accessible.* The Eight-spotted Forester, on the contrary, has no such habit, and while the only mode of combating it, is to pick the larvæ off and burn them, the Wood Nymphs may be more easily subdued by scattering a few corn cobs under the vines in the summer, to be raked up and burned in the winter.

THE AMERICAN PROCRIS—*Procris* [*Acoloithus*] *Americana*† Boisd.

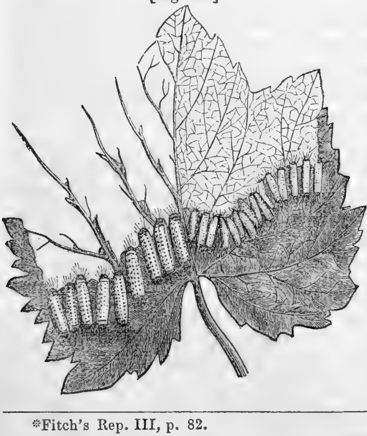
(Lepidoptera, Ctenuchidæ.)

During the months of July and August, the leaves of the Grapevine may often be found denuded of their softer parts, with nothing but the veins, and sometimes only a few of the larger ribs left skeleton-like, to tell of the mischief that has been done. Very frequently, only portions of the leaf will be thus denuded, and in that event, if we examine such a leaf closely, we shall find the authors of the mischief drawn up in line upon the yet leafy tissue with their heads all towards the margin, cutting away with their little jaws and retreating as they feed.

[Fig. 58.]



[Fig. 59.]



These little soldier-like files are formed by worms in black and yellow uniforms which produce a moth popularly known as the American Procris. The eggs from which they hatch, are laid in small clusters on the underside of the leaves, and while the worms are small, they leave untouched the most delicate veins of the leaf, which then presents a delicate net-work appearance as shown at the right of Figure 59; but when they become older and stronger they devour all but the larger ribs, as at the left of the figure.

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*Fitch's Rep. III, p. 82.

†This is the *Aglaope Americana* of Clemens, *Procris Americana* of Boisduval and Harris, and *Ctenucha Americana* of Walker.

The full grown larva (Figure 58, *a*) measures rather more than half an inch, and tapers a little towards each end. It is of a sulphur-yellow color, with a transverse row of six velvety-black, prickly tufts on each of the principle segments, the lower tufts being less distinct than those on the back. The first segment is entirely black with a yellow edge, while the spots on segments 11 and 12 usually run into one another. Head small, brown, and retractile, being usually hidden in the first segment. Fine scattering hairs anteriorly, laterally and posteriorly. The young worm is of a very pale yellow, covered with numerous fine white hairs, with a slight grayish-brown tint on the head, and with the fifth and seventh segments paler than the rest, and having the black spots scarcely visible.

When full grown these worms disperse over the vines or forsake them entirely, and each spins for itself a small, tough, whitish, flattened cocoon (Fig. 58, *c*) within which, in about three days, it changes to a chrysalis (Fig. 58, *b*), 0.30 inch long, broad, flattened and of a light shiny yellowish-brown color. In about ten days afterwards the moths (Fig. 58, *e* and *d*) begin to issue. This little moth is the American representative of the European *Procris vitis;* it is wholly of a black color, except the collar, which is of a deep orange, and the body ends in a broad fan-like notched tuft, especially in the male. The wings are of a delicate texture, reminding one of crape, and when the insect is at rest they generally form a perfect cross with the body, the hind wings being completely hidden by the front ones, which are stretched out straight at right angles, as in the genus *Pterophorus*, to which belongs the Grape-vine Plume.* I have, however, on one or two occasions found the American Procris resting in the manner shown at Figure 58, *d*.

This is the only Grape-vine feeding caterpillar which has a gregarious habit, and as gregarious insects are always more easily subdued than those of a solitary nature, the American Procris need never become very destructive. Its natural food is undoubtedly the wild grape-vines of our forests, and the Virginia Creeper, and Mr. Jordon, of St. Louis, has noticed that while it very commonly attacks the foliage of the Concord, yet it never touches the Clinton and Taylor in his vineyard—a taste which is remarkable and not easily accounted for, since the foliage of the latter kinds is more tender and generally more subject to insect depredations than that of the former.

There are two broods of this insect each year with us, some of the moths from the second brood of worms issuing in the fall, but the greater part not leaving their cocoons till the following summer. During the month of June they may be seen in pairs about the vines, and I have also frequently observed around Hermann, a very closely allied but smaller and different moth (*Acoloithus falsarius*, Clem.) about the same season of the year. This last, though so closely resembling the other, may be distinguished by being scarcely more than half as large; by the body lacking the anal tuft and being comparatively much thicker and shorter; by the hind wings being comparatively larger, and by the collar being of a paler orange and divided on the top by a black point.

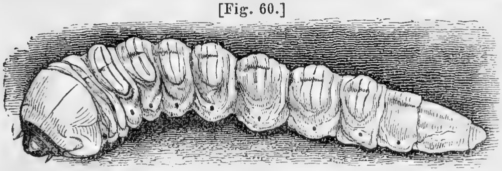
*First Rep., Pl. II, Fig. 15.

The American Procris, though the fact is not mentioned by other authors, is subject to the attack of at least one parasite, with us; for I have bred from it a very peculiar little four-winged black fly belonging to the great *Chalcis* family, and which Mr. Cresson of Philadelphia refers doubtingly to *Perilampus platygaster*, Say.

THE NEW GRAPE-ROOT BORER.

Under this head I published last year* an account of a gigantic Grape-root borer which had at that time not been bred, and of which, in consequence, the perfect insect was not with certain ly known. In

[Fig. 60.]



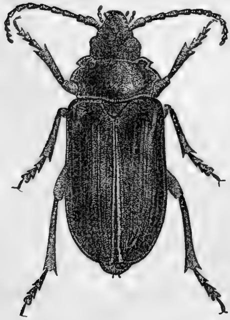
order that the reader may get well familiarized with its appearance, the figure is here reproduced (Fig. 60). For reasons then given I inferred that this borer belonged to the *Prionus* family of the Long-horned beetles, and that it would perhaps produce the Cylindrical Orthosoma (*Orthosoma cylindricum*, Fabr.), a large flattened bay-colored beetle which is common throughout the country, and especially so in the Mississippi Valley, and which I illustrated at the time. I expressed the hope to be able another year to settle this matter, and am glad to be able to do so.

Last July I bred from worms that had been sent to me the year before, as occurring in Grape root, a different, though very closely allied species to that which I had inferred they would produce, namely,

THE BROAD-NECKED PRIONUS—*Prionus laticollis*, Drury.

(Coleoptera, Prionidæ.)

[Fig. 61.]

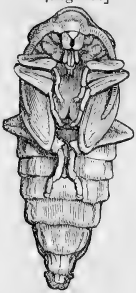


This species is usually of a darker color than the Cylindrical Orthosoma, and differs materially from that species by its larger size and broader form. The female, which is represented at Figure 61, differs from the male in having shorter and narrower antennæ, though her body is usually larger.

In all probability this insect lives nearly three years in the larva state, for three distinct sizes may be found. Those I have bred, left the roots they were inhabiting when about to become pupæ, and formed for themselves smooth oval chambers in the earth wherein they eventually cast their larval skins, and

*First Rep., pp. 124–8.

[Fig. 62.]



assumed the pupa form represented at Figure 62, but in all probability they transform within the root, when in more natural conditions. This change takes place towards the end of June, and the perfect beetle appears in about three weeks afterwards.

Soon after breeding this beetle from Grape-feeding borers, I bred a female of the same species from a very large borer which I had found the same spring, in an apple root, it having entirely killed a young apple tree, by hollowing out nearly all the roots, and by finally severing the tap root near the butt of the tree.

Thus it results that the Broad-necked Prionus bores in the larva state indiscriminately in the roots of the Grape-vine and Apple, and perhaps in those of the closely allied Pear. According to Harris it also infests the roots of different kinds of poplars, and it is consequently a pretty general feeder.

Few persons are really aware of the amount of damage these gigantic borers are capable of causing. Last March I received a long letter from Mr. Robert S. Munford, of Munfordsville, Ky., minutely describing this borer, and the manner in which it destroyed three hundred dollars' worth of his apple trees; while Mr. C. R. Edwards, of Bowling Green, Ky., writes that they have been quite injurious to his grape-vines of all varieties, though his Ionas suffered most from their attacks. Mr. Emory S. Foster, of Bushburg, sent me a specimen in May with the statement that it cut off a vine, after the fall of the leaf, and then went some six inches further down, and entered the main root, making for itself a comfortable residence where it spent the winter. Messrs. Bush and Spaulding inform me that they are continually losing vines from this borer, and that they consider it one of the worst enemies they have to contend against.

Little can be done to prevent the ravages of these underground borers after they are once in a vine, the death of which is usually the only manifestation of their presence. Still, every vine-grower should make it a rule to search for them whenever he finds vines suddenly dying from any unknown cause, and upon finding such a borer should at once put an end to its existence. The beetles, which may often be found during the summer and fall months, and which not unfrequently rush with heavy, noisy flight, into our lighted rooms, should also be ruthlessly sacrificed whenever met with. As I shall presently show, however, much may be done by judicious management to prevent their getting into the vines.

THE TILE-HORNED PRIONUS—*Prionus imbricornis,* Linn.

(Coleoptera Prionidæ.)

There is another species, the Tile-horned Prionus (*Prionus imbricornis*, Linn., Fig. 63 ♂)—so called from the joints of the male antennæ lapping over one another like the tiles or shingles of a roof—which very closely resembles the Broad-necked Prionus, and is with us much commoner. It may be distinguished at once from this last by the antennæ of the male being about 19-jointed, and those of the female about 16-jointed;* whereas both sexes of the Broad-necked Prionus have 12-jointed antennæ. In other respects, these two beetles are almost exactly alike, so that, if the antennæ happen to be broken, it is not very easy to tell one from another.

[Fig. 63.]

♂

Hitherto it has not been known upon what kind of tree this species fed, but I was fortunate enough last summer to ascertain that it also infests grape-roots. On the first of July last, Mr. Isidor Bush, of Bushburg, brought me quite a number of full-grown larvæ which he had taken from the roots of his grape vines. These were so very similar in appearance to those which produced the Broad-necked species, that I had not a suspicion they would produce anything else, and I was consequently greatly surprised when I bred from them a number of the Tile-horned species under consideration. By collecting together fibres and chips of the roots, they form a loose sort of cocoon, and transform, either inside or outside of the root, to pupæ, which resemble so closely that shown in Figure 62, that they can scarcely be distinguished from it.

We have, therefore, two distinct insects which bore into the roots of the Grape-vine, and which, though distinct, are so closely allied, that the females can only be distinguished by the number of joints in their antennæ. One of these is known to attack, besides the Grape, the Apple, the Lombardy poplar and the Balm of Gilead, and the other is very likely equally indifferent as to its choice of diet.

The accounts given in my former article, of the immense borers found in Osage Orange roots, and even in the roots of corn-stalks, undoubtedly refer to one or the other of these insects, and probably to the Tile-horned species, as that is the most common.

* Having examined nearly 20 males of this species, I have found the antennal joints to vary in number from 18 to 20, the same specimen often having a different number of joints in the right and left antenna. In one ♀ the antennæ are both of them 16-jointed, in another ♀ they are both of them 17-jointed. The typical number of joints in the Coleopterous antenna is only 11; and the number being so variable in these many-jointed antennæ is in accordance with the general rule, hat multiple parts are often variable.

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Several persons who have recognized this immense borer from the figure and description which I published last year, have informed me that they have found it on prairie land, and Mr. Wm. C. Holmes, nurseryman, of Plattsburg, writes: "The Borer described on page 124 of your Report is destroying a good many of our apple grafts, set last spring. The root not being large enough for them to work inside, they eat out about one-third of the bark, and hollow out the rest of the root. Our nursery is on prairie, broke in the fall of 1867 and spring of 1868." Now the fact of these large root-feeding borers occurring in such numbers in recently turned-up prairie land where no large roots exist, would have been perfectly inexplicable had I not been cognizant of other facts which threw light on the subject.

There is a small dimorphous male form of the Tile-horned Prionus not more than half the normal size, and of a much paler yellowish color, which is quite common in the West, and which I have found even more common around St. Louis, than the true type. I know that this form is often found in prairie regions, and my entomological friend Chas. Sonne, of Chicago, Illinois, informs me that a relation of his, Mr. F. Jæger, of Siegel, Illinois, in digging a cellar, once found immense numbers of these large grubs near the surface of the ground. A whole lot of them were sent to Mr. Sonne, and he bred from them numerous specimens of this small form of the Tile-horned Prionus, every one of them males, and every one with nineteen joints to the antennæ. On another occasion, at the same place, Mr. Sonne, having placed a lamp on a grind-stone, found that these beetles swarmed around the light, and next day upon examining a number which he captured, they all proved to be, in like manner, the small yellow form, and all males. Now, Mr. Jæger's house is remote from any timber whatever, there being but a few scrub willows here and there near by; and, from these facts, and those mentioned by Mr. Holmes, we are forced to the belief that these grubs (at least those of the small ♂ dimorphous form) are able, not only to subsist on the roots of small shrubs and very young trees, but also upon those of herbaceous plants. Mr. H. A. Mungor, of Lone Cedar, Martin county, Minnesota, has had a similar experience; for he often ploughs up these grubs in prairie land, and has captured the beetles a full mile away from any trees or shrubs, except a few specimens of a suffruticose plant known as the Lead-plant (*Amorpha Canescens*), which very seldom grows a root there, of over one-half inch diameter. He has also actually bred the beetle from pupæ found in such prairie ground. Therefore, some of the accounts—such as their occurring full grown in the roots of annuals like corn and cabbage, and in those of grape-vines but one year planted—which were not easily explained before; become perfectly clear, now that we have a better understanding of the facts in the case.

Now then comes the point of practical importance. It may with reason be argued, that it matters little to the Grape-grower to which

particular species these borers belong, so they have the habit in common, of infesting the roots of his vines. But a more important question presents itself to the thinking mind. Is any danger to be apprehended from these borers, from growing grape-vines and fruit trees among decaying oak stumps? In my former article, from the testimony of practical vineyardists, I have hinted that there is, and have advised not to plant on land covered with such stumps, or even to use oak stakes, where those made of cedar can be had; and I am glad to be able to say that this advice is well founded.

As a general rule, the larvæ of the Long-horned Boring Beetles either inhabit green and living wood or else decaying and dead wood, the same species never attacking both kinds of wood indiscriminately; and as I knew that the larva of the Cylindrical Orthosoma fed on rotten pine wood, I thought it very probable that it also fed on rotten oak stumps, and had been confounded by practical men with those of the Broad-necked and Tile-horned species, which it so much resembles. This opinion was supported by the fact that it occurred abundantly in Union county, South Illinois, in 1861, where there are no pine trees growing, and where, at that period, the so called "poplar" or white-wood was universally used in buildings, in place of pine imported from the North; and I last summer ascertained that it really does breed in rotten oak stumps, as well as in decaying pine, for I found it in the former wood, both in the larva, pupa, and fresh beetle state. But what is still more important I also find that the Broad-necked Prionus, is an exception to the rule above mentioned, and that it breeds as freely in decaying oak stumps as in living roots. For this fact I am indebted to Mrs. Mary Treat of Vineland, N. J., who has sent me specimens of the beetle bred from larvæ that are found abundant in the oak stumps in that vicinity.

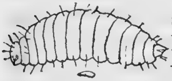
SUMMARY.—To sum up the whole matter in a few words, it is obvious that we have in Missouri three large boring grubs, which so closely resemble each other, that they cannot be distinguished by any marks which we are yet acquainted with—that the Broad-necked Prionus feeds indiscriminately on the living roots of Apple, Grapevine, Poplar (and perhaps of several other trees), and on decaying oak stumps, and will travel through the ground from one place to another—that the Tile-horned Prionus not only attacks the Grapevine, but can subsist on the roots of herbaceous plants, and in all probability will also feed on decaying oak, like the former species; and finally, that the Cylindrical Orthosoma feeds on decaying pine and oak, but has not yet been found in living roots. From these facts we may deduce the important corollary, that it will not do to leave oak stumps to rot on ground which is intended for a vineyard or orchard—which was the thing to be proved.

THE GRAPE SEED-MAGGOT—*Isosoma vitis*, Saunders.

(Hymenoptera, Chalcididæ.)

In my First Report (pp. 125–31), I gave an account of a minute maggot (Fig. 64) which had been found by Mr. Wm. Saunders, of London, C. W., to infest the seeds of growing grapes, and to occasion much damage around London and Paris, by causing the berries of the Clinton, Delaware, Rogers' No. 4, and some of Mr. Arnold's Seedlings, to shrivel up without maturing. There are so many noxious insects, common in Missouri, that occur also in the southern portions of Canada West, that it was deemed necessary to give the grape-growers of the State a diagnosis of its work, in case it should at any day make its appearance in our vineyards.

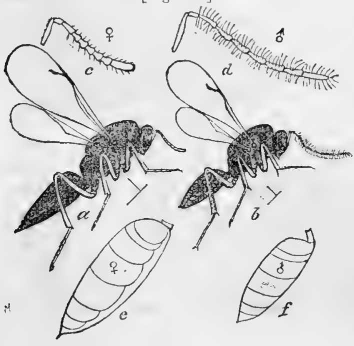
[Fig. 64.]



From the appearance of this maggot, I inferred, with every one else who gave an opinion, that it would most likely produce some small species of snout-beetle (*Curculio* family). Now mark how dangerous a thing it is, for even an entomologist to guess at the character of some insects, when in this masked form. We flatter ourselves that there are but very few insects among the half million different species that are estimated to exist in the whole extent of this terrestrial globe of ours, that we cannot place at a glance in its proper Order, even when in the larva state; but let us humbly acknowledge that there are some few larval forms among the more minute Four-winged Flies (order *Hymenoptera*) and Beetles (order *Coleoptera*) which it is almost, if not absolutely, impossible to distinguish the one from the other.

Last August I had the pleasure of spending a few hours with Mr. Saunders, at his place in London, and I was gratified to learn that he had bred the perfect insect from this seed-maggot. It proved to be a little Four-winged fly (*Chalcis* family), and upon my return home, I found a few specimens of the very same species of fly, in a bottle in which were placed some infested grapes received the year before from Mr. A. S. Fuller of New Jersey, and obtained by him from Canada.

[Fig. 65.]



This fly so closely resembles the notorious Joint-worm Fly (*Isosoma hordei*, Harris) that the accompanying highly magnified sketch (Fig. 65) of that insect—*a* representing the female, *b* the male, *c* the ♀ antenna, *d* the ♂ do., *e* the ♀ abdomen and *f* the ♂ do.—will afford a very correct idea of its appearance.

The Grape Seed-maggot Fly differs principally from the Joint-worm Fly in its somewhat smaller size, in the legs being marked

with black on the thighs and shanks, in the ♂ abdomen being comparatively shorter, and in its third ring conspicuously overhanging the fourth. The following account and description from Mr. Saunders himself, is taken from the November number of the *Canadian Entomologist:*

"In October I detached a larva from the inside of the seed, and placed it in a small glass cell between two plates of glass, in which state it remained until early in January, when it became a pupa, having first attached itself to the sides of the cell by a few short silky threads. It had now contracted in length, become nearly oval, and assumed a yellowish tint, with a few short loose silky threads adhering to different parts of its surface. On the 11th of February I examined some seeds and found the larva within, still alive and active, just as it appeared in the fall. On the 7th of July further specimens were opened and the inmates found soft and motionless; these appeared to be in the pupa state, but I did not examine them with sufficient care to enable me to be positive. During the remaining part of July, I looked many times into the bottles in which the grapes were enclosed but could not discover anything. On the 9th of August, feeling sure that the time for the appearance of the insect must be fully come, if not already past, I resolved on a thorough search for it. As soon as the contents of the bottles had been emptied on a piece of white paper, I observed a number of small four-winged flies among the dried-up grapes. They were all dead and stiff, some of them more brittle than others. From the observations made, I should judge that they made their escape from the middle to the end of July."

ISOSOMA VITIS, Saunders, ♀—*Head* large, flattened in front, black, thickly punctured, and covered with many short whitish hairs; mandibles pale brown at base, tipped with black; antennæ (scape and 8 joints), 9-jointed, black, thickly covered with whitish hairs inserted in deep sockets; the scape pale brown, slender, nearly as long as the three following joints together; the second short; third to eighth inclusive nearly equal in length; the terminal joint longer, tapering slightly towards the tip. *Thorax* black, punctured and covered with whitish hairs. *Legs*, front pair pale brown, trochanters nearly black; second and third pairs, trochanters black, femora and tibiæ nearly black along the middle, pale brown at tips; tarsi pale brown. *Abdomen*, long, black, straight, smooth, with a polished surface; placed on a short pedicel; a little contracted at base, thickest on third joint, tapering gradually to fifth, and then suddenly to extremity; the basal joint very short, second and third each somewhat longer, fourth as long as the three preceding, fifth less than half as long as fourth, sixth a little shorter, terminal joint rather longer.

♂ differs from ♀ in having the antennæ somewhat longer and more thickly covered with hairs. His abdomen is short, thick and blunt, placed on a moderately stout pedicel nearly its own length. The abdominal rings have about the same relative size as in the female, but the posterior edge of third overhangs the fourth, the latter appearing as if partially drawn within the projecting edge of the third ring.

Length ♀ 0.10, ♂, 0.06 inch.

"Having kept the grapes in bottles, only occasionally opened for ventilation, in a dry room, they had become quite hard, dry and shrivelled. In consequence of this, many of the flies were unable to make their way out, the seed having become too hard for their jaws to eat through. On opening some of these the flies were found dead with wings fully developed and surrounded by small fragments of the interior coating of the seed which they had evidently gnawed off while

endeavoring to escape. Those which had found their way out had eaten a small nearly round irregular hole through seed and skin. In many similar cases where the larva feeds within a hard substance it provides for the escape of the perfect insect by eating away the hard enclosure until it is reduced so thin as to appear almost transparent, then a very little effort is sufficient to remove the obstruction to the outward passage of the imago. In this instance I have been unable to detect any such preparation, and believe that the whole work of escape is accomplished by the perfect fly.

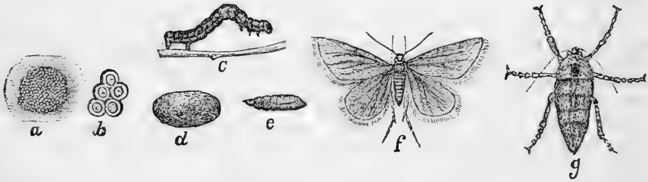
"Notwithstanding the abundance of this insect last year, I have as yet been unable to detect their presence or any evidence of their work during the present season; probably the cold and wet character of the summer has been unfavorable to their operations."

THE CANKER-WORM—*Anisopteryx vernata*, Peck.

[Lepidoptera Phalænidæ.]

This word CANKER-WORM has formed the heading of so many articles in our various Agricultural and Horticultural journals during the last ten or twelve years, and its natural history has been so fully given in the standard work of Dr. Harris, that one almost wonders

[Fig. 66.]



where there can be a reading farmer who does not know how properly to fight it. But then, new generations are ever replacing those which pass away, so that the same stories will doubtless have to be repeated to the end of time. Facts in Nature will always bear repeating, and as it may be laid down as a maxim that no injurious insect can be successfully combated without a thorough knowledge of its habits and transformations, I will first recount those of the Canker-worm, and afterwards state the proper remedy.

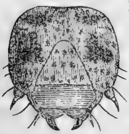
The eggs of this insect are very minute, measuring about 0.03 inch in length and 0.02 in diameter. In form they are not unlike a miniature hen's egg, minutely roughened and with longitudinal irregular depressions. They reflect prismatic colors, and are deposited close together in rows, forming batches such as that shown in the above Figure 66, *a* representing them of the natural size, and *b* rep-

resenting them magnified. They are glued together by a grayish varnish which the mother moth secretes, and they are attached to the trunk, or to some one or other of the twigs of the tree, and may often be found on the inside of loose scales of bark, each batch consisting of upwards of a hundred eggs.

As the leaves begin to form, these eggs hatch into minute, thread-like span-worms, which in from three to four weeks afterwards acquire their full size, when they appear as at Figure 66 *c*. The Canker-worm is distinguished from most other caterpillars that attack the Apple, by having but four prolegs at the end of the body. The normal number of such prolegs in caterpillars, is ten; and it is the lack of the foremost six which obliges our insect to span or loop, from which habit the characteristic name GEOMETRIDÆ has been given to the group to which it belongs.

When full-grown this worm measures scarcely an inch in length, and is commonly ash-gray on the back, darker at the side and yellowish

[Fig. 67.]



beneath. It varies greatly in the intensity of its markings however, ash-gray, green, and yellow ones occurring in the same brood, and the most constant character by which it may be distinguished from other span-worms of the same size, is the pattern of the head, which, no matter what the general hue of the body may be, is usually shaded and marked as in the annexed Figure 67. The markings of the worm vary indeed so much, that, without this criterion I could hardly venture to determine a Canker-worm larva myself.

I subjoin a very full description of this worm from numerous average specimens, as it is of considerable importance, that an orchardist may be able to ascertain definitely whether he is troubled with the true Canker-worm or not. For if he mistakes some other span-worm which produces winged females as well as winged males, for the genuine Canker-worm which is apterous in the female moth state, it becomes very obvious that all his efforts to try and prevent the ravages of the spurious Canker-worm by the most approved and well-tried methods, will not only fail most absolutely, but he will lose all faith in such remedies, and may perchance, if he is given to the use of the quill, vent his wrath and disappointment by sending to some one of the horticultural journals of the land, a pithy article "based upon FACTS [?] and EXPERIENCE" showing up the utter worthlessness of the Canker-worm remedies!

It is from such lack of true knowledge that the City Fathers of Baltimore, Maryland, went to the useless expense of furnishing oil troughs for all their large elm trees which were being defoliated, under the delusive idea that the insect committing the ravage was the Canker-worm; whereas it turned out to be the larva of a little imported Beetle (*Galeruca calmariensis*, Fabr.), the female of which has ample wings, and can fly as readily as a bird from tree to tree; and it is

from such oversights, that paragraphs like the following take their rise. This one may be found in the *Boston Journal* for may 23d, 1866:

ORIGIN OF CANKER-WORMS.—A Medford correspondent says that last fall he applied to his trees protectors which were pronounced the best in the neighborhood, and notwithstanding not a single grub passed over them, the trees, like others in the vicinity, are this season covered with worms which are now pursuing their devastating work. In his opinion the Canker-worms do not originate from the grub, and he challenges proof that they do. The subject is one worthy of investigation!

Whe-e-e-e-ou! It needs no comments in this Report.

When first hatched the young Canker-worms are of a dark olive-green or brown hue, with a shiny black head and thoracic legs, with a whitish lateral and dorsal band, the latter having a darker central line along it. After the first moult, the head becomes lighter and mottled, and the light bands less conspicuous. After the second moult the bands are almost obliterated and the body becomes more uniformly mottled and speckled with livid-brown; the head becomes still lighter and the prolegs being now large, spread out at almost a level with the venter. After the third (and I believe last) moult the appearance changes but little. The full grown larva averages 0.90 inch in length with an average diameter of 0.10 inch, being broadest on joint 11. It varies from light fleshy-gray to almost black. Head mottled as in Figure 67. Ends of body somewhat darker than middle. Joint 1 with a yellowish dorsal shield, the hinder margin in form of a rounded W. Viewed under a lens the body has a series of eight fine light yellowish, irregular, somewhat broken lines, running the whole length of the body, each one relieved by a darker shade each side of it. The two along middle of dorsum are close together, with the space between them usually dark, and occupied at anterior edge and middle of joints 5, 6, 7 and 11 by black marks somewhat in form of x, these marks being represented by simple black dots on the other joints. Space between these dorsal lines and the next lowest, lighter, and containing four black piliferous spots to each joint, the posterior ones rather further apart than the anterior ones which on joint 11 form two larger elevated shiny black spots. Space between lines 2 and 3 darker than any other part of the body. That between lines 3 and 4 lighter than any other part of body and containing the stigmata which are perfectly round and black with a light centre, with a small piliferous spot anteriorly above and below them, and another behind them, this last becoming large on joints 5, 6, 7 and 8. Venter dark and livid at borders, with a pale greenish band along the middle, which has a pinkish patch in it on joints 5, 6, 7 and 8. Legs greenish at base, color of body at extremity. The markings are most distinct on the light specimens.

The Canker-worm is by no means confined, in its destructive work, to the Apple, for it likewise attacks the Plum, the Cherry, the Elm, and a variety of other trees. Mr. R. J. Mendenhall, of Minneapolis, Minn., even informs me, in a recent letter, that "the Currant worm" spoken of in a late number of the *Farmer's Union* as infesting the currant bushes in the gardens around that city, were really Canker-worms, but he is most assuredly mistaken. The Canker-worm is seldom ever noticed on our trees till the riddled and seared appearance of the foliage tell of its presence; for, like most other span-worms, it has the habit of resting in a stiff straight posture, either at an angle of about 45° from, or flat and parallel with the twig which it occupies—thus eluding detection.

After it has attained its full size it either crawls down the tree or lets itself down by means of a silken thread, and burrows into the ground. Here, at a depth of two or three inches, it forms a rude cocoon of particles of earth intermixed with silk (Fig. 66, *d*). Within two days after completing the cocoon the worm becomes a chrysalis

of a light brown color. The sexes are now distinguishable, the male chrysalis (Fig. 66, *e*) being slender, pointed in front, and showing the wing-sheaths; while that of the female is larger and destitute of wing-sheaths.

In the latitude of St. Louis, the worms have generally descended from the trees and entered the ground by the middle of May, though some remain till about the first of June. As I have amply proved during the past two summers, there is but one brood each year in this State, just as there is but one brood in Maine, and whether the worms enter the ground the first or the last of May, they remain there as chrysalids all through the summer and fall months, and the great majority of them till the following spring. A frost seems to be necessary to their proper development. Some come out during the first mild weather that succeeds the first frosts in November; others issue all through the winter whenever the ground is thawed, and the great bulk issue as soon as the frost is entirely out of the ground in spring. Many which I bred this winter issued during the warm weather of January.

The moths (Fig. 66 *f* ♂, *g* ♀) show great disparity of sex, the male being fully winged while the female is entirely destitute of these appendages. The front wings of the male are pale ash-gray, crossed by three equidistant jagged, more or less defined, black lines, all curved inwardly, and most distinct on the front or costal border; and by a somewhat broader whitish line, which runs from the posterior angle to the apex; the inner and terminal borders also being marked with black. The hind wings are silvery-gray, and the under surfaces are of the same uniform silvery-gray color, each wing with a dusky discal spot, the front wings each with an additional spot on the costa. Such is the appearance of the more common perfect specimens found in the West, but the wings are very thin and silky, and the scales easily rub off, so that it is almost impossible to capture a perfect specimen at large. They vary considerably also—so much so that Dr. Harris ranks a smaller form as a distinct species (*A. pometaria*) which I have however bred promiscuously with the more typical specimens. The most common variation from the brief description above given, is found in such specimens which have the dark lines obsolete, and an additional white line inside the one described. The female is ash-gray, the thorax with a black spot, the body more or less marked with black along the back, and the legs alternately marked with black and white.

In Missouri the Canker-worm is not so injurious over broad tracts of country, as it is in some of the more eastern States. Yet it is sufficiently distributed in different parts, to require vigilance to keep it down. "R. P.," of Mexico, Mo., found it very injurious in the spring of 1868, and sent me many specimens, and they were the genuine article. Around Pevely, I have likewise found it common on the

farms of Dr. Varnum and Mr. Foster. Mr. Wm. M. Beal of Edina tells me that it is considered one of the very worst enemies in Knox county, and as I am informed by Mr. J. D. Dopf, editor of the *Journal*, Rockport, Atchison Co., it was exceedingly troublesome to the elms there in 1866. Where they have once become established, and are neglected, their ravages soon become very great; and they were so bad in certain parts of Michigan a few years ago, and especially in the Grand Traverse region in 1865, that, unless my memory fails me, a certain Eastern editor, in response to an appeal for a remedy from Mr. Sanford Howard, the Secretary of the Michigan State Board of Agriculture very foolishly urged the Wolverines to cut down their trees. May I hope that these Entomological Reports will be the means of protecting Missouri from the fearful ravages of this worm which has so often discouraged the orchardists in Massachusetts, Rhode Island, Connecticut, and some of the Middle States.

It is the apterous condition of the female moth which gives us such complete control of this enemy, and which indicates

THE PROPER REMEDY.

The sole object of the female, after she leaves the earth, seems to be to provide for the continuance of her kind, and she instinctively places the precious burden, which is to give birth to the young which she herself is destined never to behold, upon the tree whose leaves are to nourish those young. All her life-energy is centered in the accomplishment of this one object, and she immediately makes for the tree upon issuing from the ground. Consequently, anything that will prevent her ascending the trunk will, in a great measure (but as we shall presently see, not entirely) preserve the tree from the ravages of the worm.

Numerous indeed have been the devices—patented or unpatented—which have at different times and in different parts of the country been used to accomplish this desired end; and every year our Agricultural journals report individual experiments with some one or other of these devices—some favorable and others adverse. Tar, applied either directly around the body of the tree, or on strips of old canvas, on sheep-skin, or on stiff paper; refuse sorghum molasses, printers' ink, or slow-drying varnishes, or melted India rubber, which always retains its soft viscid state, applied in a similar manner; tin, lead, and rubber troughs to contain oil; belts of cotton-wool, etc., etc., have all been used, and with both good and bad results, very much according as they have been used intelligently or otherwise. Now, all these appliances, of whatsoever character, are divisible into two classes: first, those which prevent the ascension of the moth by entangling her feet, and trapping her fast, or by drowning her; and, second, those which accomplish the same end by preventing her from getting a foothold, and thus causing her repeatedly to fall to the ground until she becomes exhausted and dies.

The first class of remedies are thoroughly effectual when applied understandingly and persistently. And by this I mean, that the orchardist must know that many of the moths issue in the fall of the year, and that the applications must, in consequence, be made at least as early as the latter part of October, and that they must be kept sticky, through all but freezing weather, till the leaves have well put out, in the following spring. Furthermore he must know that many of the moths—frustrated in their efforts to climb the tree—will deposit their eggs near the ground or anywhere below the application, and that the young worms hatching from them are able to pass behind the slighest crevice or over the finest straw. Thus, if troughs are used, they must be fitted over a bandage of cotton-wool, so that when the trough is drawn tightly around the tree, it will do no injury, and will at the same time cause the cotton to fill up all inequalities of the bark; the joint must likewise be kept smeared either with tar or molasses, and then the worms will not be able to pass. In the neglect to thus fasten them, lies the secret of failure which many report who use such troughs. The second class of contrivances are of no avail whatever, for although the moth is unable to travel over a very smooth surface, I know from experience that the young worms can march over the smoothest glass by aid of the glutinous silken thread which they are able to spin from the very moment they are born. For these reasons, even the "Merritt's Patent Tree-Protector," which was so well advertised by Mr. Howard in his otherwise excellent article on the Canker-worm, in the Michigan Agricultural Report for 1865, must be classed with the worthless patents. This "Protector" consists of a ring of glass grooved below and hung from the tree by a tent of canvas, to which it is fastened by an iron clamp.

I might enumerate a number of such ingenious contrivances both of glass, wood, tin, and isinglass, for heading off the female moth *only*, and some few which are sufficiently thorough to head off the young larvæ also; but they are all so expensive, that I am perfectly convinced they will never be adopted in our large orchards; nor are they necessary, for some of the remedies already mentioned are altogether more simple and more effectual.

It cannot be denied that it requires a great deal of time, labor and expense to continually renew the applications of tar on every tree in a large orchard during so many months of the year; while its application directly to the bark is more or less injurious to the trees. For these reasons, refuse sorghum molasses will be found much better for the purpose, as it does not harden so rapidly, and is said not to be injurious to the tree. In neighborhoods where sorghum is grown, it is also much cheaper. That it will pay to do this work in orchards where the Canker-worm is known to be numerous, there cannot be the least doubt. The old adage, "What is worth doing at all is worth doing well," was never truer than in fighting this insect.

Apply the remedy thoroughly during two successive years, and you have utterly routed the enemy, and this is more especially the case where an orchard is not in too close proximity to the timber, or to slovenly neighbors. Fail to apply the remedy, and the enemy will, in all probability, rout you. The reason is simple. The female being wingless, the insect is very local in its attacks, sometimes swarming in one orchard and being unknown in another which is but a mile away. Thus, after it is once exterminated, a sudden invasion is not to be expected, as in the case of the Tent Caterpillar, and of many other orchard pests; but when it has once obtained a footing in an orchard, it multiplies the more rapidly, for the very reason that it does not spread fast.

If oil troughs are used, it will be found much safer, and surer to sink them in the ground close around the butt of the tree, instead of winding them around the trunk higher up. There will then be no chance for the young worms to get up between the trough and the tree. But it follows, that this plan can only be adopted in an orchard which is kept perfectly clean.

As for muriate of lime, which has been so earnestly recommended as a preventive, by interested parties, here is what Mr. Sanford Howard says of it in the *Western Rural* of August 18th, 1866, and Mr. Joseph Breck, editor of the old American *Journal of Horticulture*; G. C. Brackett, correspondent of the *Maine Farmer*, and several other persons with whom I am acquainted, all testify, after having thoroughly tried it, to its utter worthlessness for this purpose:

The editor of the *Farmer* says, there are statements to the effect, that a substance called Gould's Muriate of Lime, applied to the soil in autumn, had entirely prevented the subsequent appearance of Canker-worms on trees standing on the ground, although the trees had previously been much damaged by the insect. It is also stated that on other trees, not ten rods distant, where none of the so-called muriate of lime was applied, the worms were very destructive.

I cannot think that this amounts to any proof that the substance applied destroyed the worms, or had any effect on them. The non-appearance of the insect in the case alluded to, was probably due to other causes. If this substance will kill or injure the insect in any of its stages, it would be easy to prove it by a direct application to soil containing insects, in a box. Several years ago, I took pains to make a particular experiment with this so-called muriate of lime, the result of which was that the Canker-worm underwent its transformations naturally, and to all appearance healthfully, in a soil composed of nearly fifty per cent. of the articles of which it was said a small proportion only was necessary to totally destroy them? If the substance is the same in composition now that it was then, it is reasonable to suppose that the result of its application would be the same.

As to the "Plug Ugly Theory," which consists of filling an auger bore with sulphur and plugging it tight, and which originated, some years since, in the inventive brain of some *Prairie Farmer* correspondent; it is altogether too absurd to need consideration, for even if the mode of application were not so downright ridiculous, it is well

known to entomologists that many caterpillars will thrive exceedingly on leaves that have been thickly sprinkled with sulphur.

Vigilance is the price of reward, and as it is always easier to prevent than to cure, it were well for the owners of young orchards, in neighborhoods where the Canker-worm is known to exist, to keep a sharp look-out for it; so that upon its first appearance the evil may be nipped in the bud. In the same manner that it is exterminated in the individual orchard, in like manner, it may, by concert of action, be exterminated from any given locality. When once the worms are on a tree, a good jarring will suspend them all in mid-air, when the best way to kill them is by swinging a stick above them, which breaks the web, and causes them to fall to the ground; when they may be prevented from ascending the tree, by the methods already described, or by strewing straw on the ground and setting fire to it.

One word in commendation of late fall plowing and the use of hogs. A good deal has been said both for and against fall plowing, and the following discussion which took place at the November (1868) meeting of the Alton (Ills.) Horticultural Society, will afford a sample of the different opinions held by individuals:

Dr. Long took the ground that fall plowing was one of the best and surest means of eradicating those insects which stay in the ground over winter. He said, some five or six years ago my orchard was badly infested with the Canker-worm; by late cultivation, I almost, if not entirely, got rid of them.

Dr. Hull—I do not believe that fall plowing will destroy the larvæ of insects to any extent. I have dug up frozen lumps containing larvæ that were not affected by freezing. I think the Canker-worm will not spread here as in New England.

J. Huggins—I have been led to believe—contrary to Dr. Hull's statement—that they will spread, and feel that there is great danger of their spreading. I believe fall plowing a great aid in the extermination of them. Cites a case where they have been almost entirely destroyed by late plowing, in an orchard that was nearly ruined by them.

Dr. Hull—If it be true that they will spread, why is it that none of Dr. Long's neighbors have them? He says he was badly overrun with them, and the fact that his neighbors were not, I think confirmation of my statement that they will not spread.

Dr. Long—My brother's orchard, adjoining mine, had double as many as my own. He fall plowed, and has very few left. He also cites the case of an old orchard, in this section, that was almost destroyed by them, but fall plowing has almost, if not entirely, destroyed them.

The following item from the New York Weekly *Tribune* of February 26th, 1869, also bears on this point:

Canker-worms Destroyed by Plowing.—Mr. McNeil Witherton, in answer to W. V. Monroe's request: I will state that I think that the Canker-worm can be destroyed by plowing the ground where they are, late in the fall. The 25th of Nov., 1867, I was at my son David's in Wisconsin. He told me that the Canker-worms were in his orchard, and had injured his apple trees very much the past season; that a man who owns a nursery and keeps apple trees for sale, went into the orchard and examined the trees and worms, and said it was the Can-

ker-worm that was injuring his orchard. I told him that about fifty years ago they had been in my father's orchard some six years, and killed a large number of the trees; that we plowed it late in the fall, and have never seen the Canker-worm there since. I advised him to plow his orchard immediately. The next day he plowed it as far as the worms had been in it. I received a letter from him a few weeks ago, stating that the Canker-worms were not in his orchard this year, and those trees that were injured and not killed last year, revived some this year.

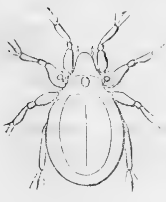
Now there is no doubt but late plowing will produce somewhat different effects, according to the character of the soil, and the depth of the plowing; but that it is more generally beneficial than otherwise I am perfectly convinced, and as for the assertion of Mr. Wm. P. Lippincott, of Vernon, Iowa, made some time ago, in the *Iowa Homestead*, namely, that it left the ground full of harbors for the next year's breeding, it suffices to say that the insect does not breed in the ground, and, holes or no holes, the worms will penetrate the soil whenever the time arrives to change to chrysalis. After the summer months the insect invariably lies in the chrysalis state snugly entombed in a little earthen cell very thinly lined with silk, from two to six inches below the surface. This cell, though frail, is a sufficient protection, so long as it is whole, from any excess of moisture, and at the same time prevents too much evaporation in case of summer drouth or dry winter freezing. Now I have proved by experiment that whenever this cell is disturbed or broken in cold weather, the chrysalis has not the power to penetrate the ground again, and in the great majority of instances, either rots, dries out, becomes mouldy, or, if on the surface, is devoured by birds. Even summer plowing, if performed after the first of July would work beneficially; and it is for this reason, that clean, well cultivated orchards are more free from the attacks of this insect, than slovenly and neglected ones. The only advantage of late fall plowing, lies in the facts, that the chrysalis is at that time too benumbed to work itself into the ground and form another cell, and that birds are then harder pushed for food, and more watchful for any such dainty morceau.

As to the efficiency of hogs, in rooting up and devouring the chrysalids, during the summer months, abundant favorable testimony might be cited; but the facts are too obvious to need argument.

ENEMIES OF THE CANKER-WORM.

Like most of our noxious insects, the Canker-worm is subject to the attacks of cannibal and parasitic insects. It is also devoured by very many different birds, some of which almost entirely live on it; and Dr. Packard, of Salem, Mass., has observed an elongated mite (*Nothrus ovivorus*, Fig. 68, enlarged) devouring its eggs. The most common parasite which I have yet discovered with us, is an undescribed small four-winged fly belonging to the genus *Microgaster*, of the same size, but differing from the Military Micro-

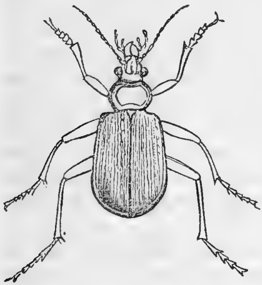
[Fig. 68.]



gaster (Fig. 23) which preys upon the Army-worm. It differs also from most other insects of the same genus, by each individual larva as it eats through the skin of the Canker-worm, spinning its pale greenish-white cocoon alone, and not in company. About ten per cent. of the worms which I have endeavored to breed, have been destroyed by this parasite. Harris mentions the larva of another four-winged fly, and that of a two-winged fly belonging to the genus *Tachina*, which also infest the worm, destroying about one-third of them in Massachusetts. There is also a very minute and undescribed species of *Platygaster* which pierces the egg of the Canker-worm, and drops one of her own into it, from which in due time the perfect fly develops.

Among the Cannibal insects, which prey upon it, may be mentioned the Ground-beetles, two of which I have found preying upon this worm, namely, the Rummaging Ground-beetle (*Calosoma scrutator*, Fabr. Fig. 69), a large and beautiful insect, with the wing-covers golden-green, and the rest of the body marked with violet-blue, gold, green, and copper; and the Fiery Ground-beetle (*Calosoma calidum*, Fabr. Fig. 70.), a black species of almost equal size, with copper colored spots on the wing-covers. These beetles are very active, and run over the ground in search of soft-bodied worms, and will even mount upon the trunks of trees for the same purpose.

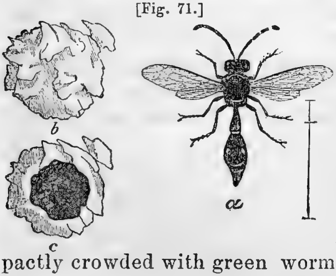
[Fig. 69.]



[Fig. 70.]

The Fraternal Potter-wasp (*Eumenes fraterna*, Say), is stated by Harris, to store her cells with Canker-worms, often gathering eighteen or twenty of them for a single cell. This wasp (Fig. 71, *a*), is quite common in St. Louis county, and uses other species besides Canker-worms as food for its young. Its clay nest (Fig. 71 *b*, entire; *c*, the same cut open shortly after it was built, showing the manner in which it is compactly crowded with green worms), may often be found attached to the stems of the Goldenrod and of other plants in the open air, or cemented under the loose bark of some tree. It has even been found attached to the leaves of a deciduous plant, where it must necessarily fall to the ground in winter and lie there till the perfect insect issues in the following summer.

[Fig. 71.]



CABBAGE WORMS.

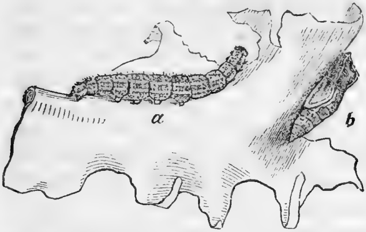
Of the various insects that affect this important esculent, the three following are among the most injurious in this State:

THE SOUTHERN CABBAGE BUTTERFLY—*Pieris protodice*, Boisd.

(Lepidoptera, Pieridæ.)

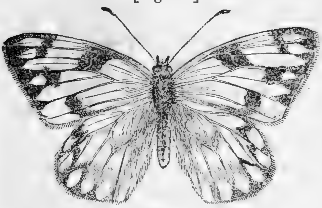
Mr. S. H. Scudder, of the Boston Society of Natural History, from an examination of a large number of specimens of this butterfly,

[Fig. 72.]



found that it enjoys a wide geographical range, "extending from Texas on the southwest, Missouri on the west, and the mouth of the Red River of the North on the northwest, as far as Connecticut, and the Southern Alantic States on the east."* But while the species is scarce in the more northern States, it is the common white butterfly of Missouri, abounding in many parts of the State, and sometimes flitting so thickly around the truck gardens near large cities, as to remind one at a distance, of the falling of snow. It often proves exceedingly injurious, and I learn from a Mississippi exchange, that "there were last year thousands of dollars' worth of cabbages devastated and ruined by worms in the neighborhood of Corinth." The paragraph goes on to state, "that cabbages could not, in consequence, be had there even at ten cents per head." The "worm" referred to, was doubtless the species under consideration.

[Fig. 73.]



I have often passed through cabbage beds near St. Louis, and been unable to find a perfect head, though few of the gardeners had any suspicion that the gay butterflies which flitted so lazily from one plant to another, were the real parents of the mischievous worms which so riddled the leaves.

The larva (Fig. 72, *a*) may be summarily described as a soft worm, of a greenish-blue color, with four longitudinal yellow stripes, and covered with black dots. When newly hatched it is of a uniform orange color with a black head, but it becomes dull brown before the first moult, though the longitudinal stripes and black spots are only visible after said moult has taken place.

I subjoin a more complete description of it:

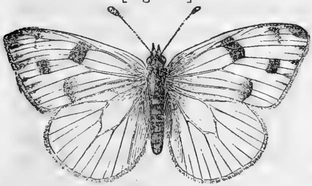
Average length when full grown 1.15 inches. Middle segments largest. Most common ground-color green verging onto blue; sometimes clear pale blue and at others deep indigo or

* See Proc. Bost. Soc. Nat. Hist., VIII, 1861, p. 180.

purplish-blue. Each segment with six transverse wrinkles, of which the first and fourth are somewhat wider than the others. Four longitudinal yellow lines, each equidistant from the other, and each interrupted by a pale blue spot on the aforementioned first and fourth transverse wrinkles. Traces of two additional longitudinal lines below, one on each side immediately above prolegs. On each transverse wrinkle is a row of various sized, round, polished black, slightly raised, piliferous spots; those on wrinkles one and four being largest and most regularly situated. Hairs arising from these spots, stiff and black. Venter rather lighter than ground-color above, and minutely speckled more or less with dull black. Head same color as body; covered with black piliferous spots, and usually with a yellow or orange patch each side—quite variable. The black piliferous spots frequently have a pale blue annulation around the base, especially in the darker specimens.

The chrysalis (Fig. 72, *b*), averages 0.65 inch in length, and is as variable in depth of ground-color, as the larva. The general color is light bluish-gray, more or less intensely speckled with black, with the ridges and prominences edged with buff or with flesh-color, and having larger black dots.

[Fig. 74.]

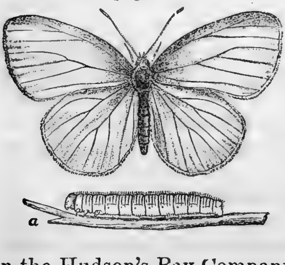


The female butterfly (Fig. 73) differs remarkably from the male which I represent at Figure 74. It will be seen, upon comparing these figures that the ♀ is altogether darker than the ♂. This sexual difference in appearance is purely colorational, however, and there should not be the difference in the form of the wings which the two figures would indicate, for the hind wings in the ♂ cut, are altogether too short and rounded.

This insect may be found in all its different stages through the months of July, August and September. It hybernates in the chrysalis state. I do not know that it feeds on anything but Cabbage, but I once found a ♂ chrysalis fastened to a stalk of the common nettle (*Solanum carolinense*), which was growing in a cemetery with no cabbages within at least a quarter of a mile: and Mr. J. R. Muhleman is reported as having stated at a late meeting of the Alton (Illinois) Horticultural Society, that it is injurious to turnips and other plants of the cabbage family. There are two broods of this insect each year.

As already stated, in the more northern and eastern States our Southern Cabbage Butterfly occurs in comparatively small numbers, but it is replaced by the Potherb Butterfly (*Pieris oleracea*, Boisd.), an indigenous species which does not occur with us. This last (Fig. 75, butterfly with the larva beneath) is in reality a northern species, for it rarely reaches as far south as Pennsylvania, but extends east to Nova Scotia, west to Lake Superior, and north as far as the Great Slave Lake in the Hudson's Bay Company's territory. It is readily distinguished

[Fig. 75



from our species by being perfectly plain, with no black spots on the wings. The body is black, and the front wings have a slight shade of this color at their base, front edge, and tips. Its larva is pale green and feeds on various other cruciferous plants besides cabbages; its chryalis (Fig. 76) is also pale green or whitish, regularly and finely dotted with black.

[Fig. 76.]

This butterfly has existed from time immemorial on the American continent, within the geographical limits already given, and yet has never made its way into Missouri or any of the southwestern States. Nor is it likely to ever do so; and why? Because some insects are constitutionally incapacitated to live beyond certain geographical limits. The range of an insect is governed by various influences which I have not time to enumerate at present; but the principal influence is undoubtedly climate—temperature—heat. The "isothermal" lines, or the lines of equal heat, as all physical geographers are well aware, do not run parallel with the lines of latitude, as one might at first thought suppose; but if our isothermal maps are to be relied on, vary most astonishingly to points north and south of a given line. The same variation from a given line of latitude is noticeable in the distribution of insects, or—to coin a word—we have "isentomic," or iso-insect lines, which are as variable as the lines of equal heat, by which they are doubtless to a great extent governed. In Central Missouri we live on nearly the same latitude as that of Southern Pennsylvania, and in North Missouri, as that of Southern New York; yet we do not live on the same insect line, but nearly on that of Virginia and North Carolina, and even in the extreme northern part of the State, a number of insects are found, which on the Atlantic seaboard are never known to occur north of Virginia, and the same rule holds good with the birds and fishes of the United States. The same thing is true of our Central and Southern counties. In other words many of our insects are *southern*, not *northern* species, and as familiar examples, I might mention the Tarantula of Texas (*Mygale Hentzii*, Girard), and its large Digger-wasp enemy (*Pepsis formosa*, Say), which have been frequently found in St. Louis county during the past two years, though they were for a long time supposed to be confined to Texas.

Now, since the indigenous Potherb Butterfly has never, in the course of past ages, extended to any point South of Pennsylvania, although its cruciferous food-plants have always flourished South of that line, we are justified in concluding that it never will do so, and that though a brood of the worms were introduced directly on to some cabbage patch in the extreme Northern part of this State, they would soon die out there.

Consequently we have nothing to fear from this butterfly which has always troubled our northeastern friends. But the case is very different with another white cabbage butterfly which is now committing sad havoc to the cabbages in some parts of Canada, and some

of the Eastern States. The species I refer to is the Rape Butterfly (*Pieris rapæ*, Schrank), a recent importation from Europe, and while I have no fear of any evil results arising from the introduction of the Potherb Butterfly, I should hate to try the experiment of introducing a brood of worms of the Rape Butterfly into any portion of the State; because, for the reasons detailed in the paper read before the State Horticultural Society, and which is published at the beginning of this Report, I have not a doubt but they would flourish exceedingly, and become far more injurious than either of the indigenous species. Indeed, the history of this insect, since its introduction into this country, affords sufficient proof that such would be the result, for M. Provancher in a recent number of his journal, *Le Naturalista Canadien*, says that it alone, has caused more damage around Quebec, since its arrival there, than all other noxious butterflies put together, in the same space of time; and he estimates that it annually destroys $240,000 worth of cabbages around that town. In short, as this insect is rapidly spreading westward, there is every reason to fear that it may some day get a foothold in our midst, unless the proper measures are taken to prevent such an undesirable occurrence. It will be well therefore to familiarize the reader with its appearance, for "to be forewarned is to be forearmed!"

Little did I dream, when, many years ago, I watched this butterfly fluttering slowly along some green lane or over some cabbage patch in England, where it is THE butterfly; or when I found its chrysalis so abundantly in the winter time on old palings or even on the kitchen wall indoors—that I should some day be fearing its presence here. But just as little did our forefathers dream of the immense though gradual changes which have come over this broad land during the last two or three centuries! Coming events are said to cast their shadows before them, but verily we know not what the morrow will bring forth.

This Rape Butterfly is the bane of every cabbage grower, and its larva is the dread of every cook in many parts of Europe. Unlike the two indigenous N. A. species already alluded to, this worm is not content with riddling the outside leaves, but prefers to secrete itself in the heart, so that every cabbage has to be torn apart and examined before being cooked, and it is also necessary to keep a continual lookout, even after it is dished up, lest one gets such an admixture of animal and vegetable food as is not deemed palatable by the most of men. It is on account of this habit of boring into the heart of cabbages, that the French call it the "Ver du Cœur" or Heart-worm.

It was introduced about 1856 or 1857, having been first taken in Quebec in 1859. In 1864 Mr. G. J. Bowles, who published an account of it in the *Canadian Naturalist and Geologist*, for August, 1864, p. 258, estimated that it had not then extended more than forty miles from Quebec as a centre. In 1866 it was taken in the northern parts of New Hampshire and Vermont; in 1868 it had advanced as far

South as Lake Winnepesaugee. It having since been taken at Bangor, and at other points in Maine; in certain parts of New Jersey, and the past year around Boston and New York.

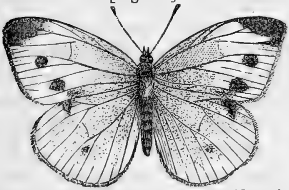
It was in all probability introduced into this country in the egg state, for the eggs are deposited on the underside of the leaves, and there is nothing more likely than that a batch may have been thrown with refuse leaves from some vessel, and that after hatching the young larvæ managed to find suitable food close by.

[Fig. 77.]

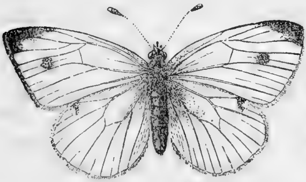
The larva (Fig. 77, *a*), is pale green, finely dotted with black, with a yellowish stripe down the back, and a row of yellow spots along each side in a line with the breathing holes. When about to transform, it leaves the plant upon which it fed, and shelters under the coping of some wall or fence, or on anything that may be conveniently at hand, and changes to a chrysalis (Fig. 76, *b*) which though variable in color, is usually pale green, speckled with minute black dots. The insect passes the winter in this state and as with the two indigenous species, there are two broods each year.

The butterflies have the bodies black above, with the wings white, and marked as in the accompanying cuts; the female (Fig. 78) being distinguished from the male (Fig. 79) by having two round spots (sometimes three) instead of only one on the front wings. Underneath, both sexes are alike, there being two spots on the front wings and none on the hind ones, which are yellowish, sometimes passing into green. The species varies very much, and there is a specimen in my collection in which all the spots are so nearly obsolete above, that if it were not for the characteristic under-surfaces, it could scarcely be distinguished from the Potherb Butterfly. There is also in England a variety of the male sex which has the ground-color canary yellow instead of white, and curiously enough, this same variety has been taken in this country.

[Fig. 78]



[Fig. 79.]

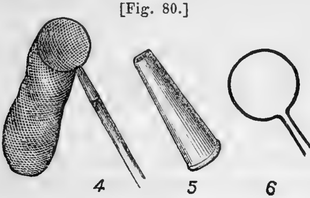


Although some caterpillars are polyphagous, feeding indiscriminately on a great variety of plants, yet most of them are confined to plants of the same botanical family, or at all events of the same natural order. Such is the case with the two indigenous cabbage butterflies above mentioned, for they are not known to go beyond cruciferous plants for food. The Rape Butterfly has a less epicurean palate however, and departs from this rule, inas-

much as it has been known to feed upon the weeping willow in England.

REMEDIES.—One way of counterworking the evil effects of these cabbage butterflies, is to search for the eggs at the proper season, and destroy them. These eggs are pear-shaped, yellowish and longitudinally ribbed, but as they are deposited singly or in clusters of not more than two or three, the operation becomes tedious and somewhat impracticable on a large scale. Still, children should be taught how to find them, and incited to search for them by the hope of a reward for a certain number. The butterflies are slow lumbering flyers and may easily be caught in a net and killed. A short handle, perhaps four feet long, with a wire hoop and bag-net of muslin or musquito netting, are the only things needed to make such a net, the total cost of which need not be more than fifty or seventy-five cents. Or a more durable one may be made, in the following manner: Get a tinsmith to make a hollow handle of brass or tin from six to seven inches in length and tapering at one end, as seen in Figure 80, 5; then procure a piece of stout wire, rather more than a yard long, and bend it in the manner shown in Figure 80, 6. Place the ends of the wire in the small end of the handle, solder it on, and then fill in one-third of the handle with molten lead, so as to make the wire doubly fast and solid. Now make a bag of some strong but light fabric, and fasten it well to the wire. The depth of the bag should be more than twice the diameter of the wire hoop. If a handle is required, a wooden one is easily made to fit into the hollow brass or tin, as at Figure 80, 4. Poultry, if allowed free range in the cabbage field, will soon clear off the worms of our indigenous species.

[Fig. 80.]



By laying pieces of board between the cabbage rows, and supporting them about two inches above the surface of the ground, the worms will resort to them to undergo their transformations, and may then be easily destroyed.

Either Paris green or white hellebore will kill the worms, if sprinkled on to them, but cannot be used on cabbages, as it is difficult to free the plants of these substances which are poisonous. The saponaceous compounds of cresylic acid are effectual, and without these objections.

In Europe there are many parasites which serve to check the increase of the Rape Butterfly, and Curtis enumerates at least four. But on this continent, but one such parasite has so far been found to attack it, and that was a two-winged fly—probably a *Tachina* fly—which M. Provancher bred from the chrysalis, in Quebec, Can.* M. Provancher, after remarking that he found a chrysalis which, from its blacken-

*(*Naturaliste Canadien* Vol. II, p. 18.)

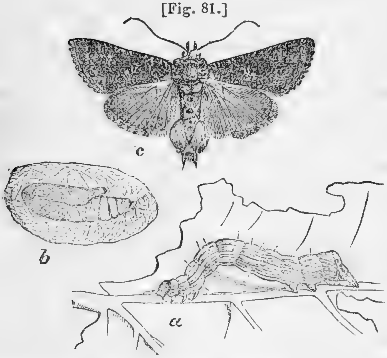
ing in the middle, he suspected would not develop into a butterfly, says of this parasite that he afterwards found a cocoon [pupa?] by its side which was smooth blackish and oblong, and so large that he could scarcely believe it had escaped from the chrysalis, which was, however, now pierced in the middle and empty. M. Provancher goes on to say: "Ten days afterwards, we perceived one morning that the cocoon was open at one end, and there was buzzing about in the vial a fly, which we recognized as belonging to the genus *Sarcophaga* [flesh-flies], the larvæ of which are known to develop in meat. Here then, we exclaimed, when we saw this fly, is an enemy of the Rape Butterfly. But unfortunately the flesh-flies feed indiscriminately on almost any kind of flesh, and never being very numerous, cannot become very redoubtable enemies of this butterfly."

With all due respect to my friend Provancher, I incline to believe that he has mistaken a *Tachina* fly which is a true parasite, for a flesh-fly (*Sarcophaga*) which is only a scavenger. And if this be so, his reasoning falls to the ground, for, as we may see in the Army-worm article in this Report, there are no more efficient checks to the increase of injurious insects than these same *Tachina* flies.

THE CABBAGE PLUSIA—*Plusia brassicæ*, N. Sp.

(Lepidoptera, Plusidæ.)

[Fig. 81.]



This is the next most common insect which attacks the Cabbage with us, and curiously enough it has never yet been described. It is a moth, and not a butterfly, and flies by night instead of by day. In the months of August and September the larva (Fig. 81, *a*) may be found quite abundant on this plant, gnawing large, irregular holes in the leaves. It is a pale green translucent worm, marked longitudinally with still paler more opaque lines, and like all the known larvæ of the family to which it belongs, it has but two pair of abdominal prolegs, the two anterior segments which are usually furnished with such legs in ordinary caterpillars, not having the slightest trace of any. Consequently they have to loop the body in marching, as represented in the figure, and are true "Span-worms." Their bodies are very soft and tender, and as they live exposed on the outside of the plants, and often rest motionless, with the body arched, for hours at a time, they are espied and devoured by many of their enemies, such as birds, toads, etc. They are also subject to the attacks of at least two parasites and die very often from disease, especially in wet weather:

so that they are never likely to increase quite as badly as the butterflies just now described.

When full grown this worm weaves a very thin loose white cocoon, sometimes between the leaves of the plant on which it fed, but more often in some more sheltered situation; and changes to a chrysalis (Fig. 81, *b*) which varies from pale yellowish-green to brown, and has a considerable protruberance at the end of the wing and leg cases, caused by the long proboscis of the enclosed moth being bent back at that point. This chrysalis is soft, the skin being very thin, and it is furnished at the extremity with an obtuse roughened projection which emits two converging points, and several short curled bristles, by the aid of which it is enabled to cling to its cocoon.

The moth is of a dark smoky-gray inclining to brown, variegated with light grayish-brown, and marked in the middle of each front wing with a small oval spot and a somewhat U-shaped silvery white mark, as in the figure. The male (Fig. 81, *c*) is easily distinguished from the female by a large tuft of golden hairs covering a few black ones, which springs from each side of his abdomen towards the tip.

The suggestions given for destroying the larvæ of the Cabbage Butterflies, apply equally well to those of this Cabbage Plusia, and drenchings with a cresylic wash will be found even more effectual, as the worms drop to the ground with the slightest jar.

PLUSIA BRASSICÆ, N. Sp.—*Larva*—Pale yellowish translucent green, the dorsum made lighter and less translucent by longitudinal opaque lines of a whitish-green; these consist each side, of a rather dark vesicular dorsal line, and of two very fine light lines, with an intermediate broad one. Tapers gradually from segments 1–10, descending abruptly from 11 to extremity. Piliferous spots white, giving rise to hairs, sometimes black, sometimes light colored; and laterally a few scattering white specks in addition to these spots. A rather indistinct narrow, pale stigmatal line, with a darker shade above it. Head and legs translucent yellowish-green, the head having five minute black eyelets each side, which are not readily noticed with the naked eye. Some specimens are of a beautiful emerald-green, and lack entirely the pale longitudinal lines. Described from numerous specimens.

Crysalis—Of the normal *Plusia*-form, and varying from yellowish-green to brown.

Moth—*Front wings* dark gray inclining to brown, the basal half line, transverse anterior, transverse posterior, and subterminal lines pale yellow inclining to fulvous, irregularly undulate, and relieved more or less by deep brown margins; the undulations of the subterminal line more acuminate than in the others, and forming some dark sagittate points; the basal half-line, the transverse anterior near costa, and the transverse posterior its whole length, being sometimes obscurely double: four distinct equidistant costal spots on the terminal half of wing, the third from apex formed by the termination of the transverse posterior; posterior border undulate with a dark brown line which is sometimes marked with pale crescents; a series of similar crescents (often mere dots) just inside the terminal space; the small sub-cellulary silver spot oval, sometimes uniformly silvery-white but more often with a fulvous centre, sometimes free from, but more often attached to the larger one which has the shape of a constricted U, very generally with a fulvous mark inside, which extends basally to the transverse anterior at costa. Fringes dentate, of the color of the wing, and with a single undulating line parallel to that on the terminal border. *Hind wings* fuliginous, inclining to yellowish towards base, and with but a slight pearly lustre; fringes very pale with a darker inner line. Under surfaces pale fuliginous with a pearly lustre, the front wings with a distinct fulvous mark under the sub-cellulary spots, speckled more or less with the same color around the borders of the wing, the fringes being dentate with light and dark; the hind wings speckled with fulvous on their basal half, and with the fringes as above. *Thorax* variegated with the same color as front wings, the tufts being fulvous inclining to

pink. *Abdomen* ♀ gray, with a few pale hairs near the base, and scarcely extending beyond the margin of the hind wings; ♂ longer, covered with pale silky hairs, a distinct dorsal brown tuft on each of the three basal segments, and two large lateral either fawn-colored or golden-yellow brushes on the fifth segment, meeting on the back and partly covering two smaller brushes on the sixth, which are tipped with black; terminal segment flattened and with two lateral more dusky and smaller tufts: underside of thorax and abdomen gray, mixed with flesh-color. Alar expanse 1.55 inches. Described from numerous bred specimens. In a suite of specimens bred from the same brood of larvæ a considerable difference in the general depth of color is found, some being fully as dark again as others.

Closely resembles *Plusia ni*, Engr., which occurs in Italy, Sicily, France, and the northern parts of America. Mr. P. Zeller of Stettin, Prussia, to whom I sent specimens, considers it distinct however from the European *ni*, and I have consequently given it a name in accordance with its habits.

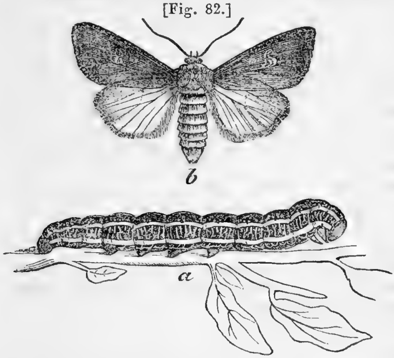
There is another worm which may be known as the Thistle Plusia, and which occurs on our common thistles, and cannot therefore be considered very injurious. It differs only from that of the Cabbage Plusia in having the sides of the head, the thoracic legs, a row of spots above the lateral light line, and a ring around the breathing pores, black. I have bred from it the *Plusia precationis** of Guenée—an insect whose larval history has not hitherto been known.

THE ZEBRA CATERPILLAR—*Mamestra picta*, Harr.

(Lepidoptera, Apamidæ.)

This is another insect which often proves injurious to our cauliflowers and cabbages, though it by no means confines itself to these two vegetables. Early in June the young worms which are first almost black, though they soon become pale and green, may be found in dense clusters on these plants, for they are at that time gregarious. As they grow older they disperse and are not so easily found, and in about four weeks from the time of hatching they come to their full growth. Each worm (Fig. 82. *a*,) then measures about two inches in length, and is velvety-black with a red head, red legs, and with two lateral yellow lines, between which are numerous transverse white, irregular, zebra-like finer lines, which induced Dr. Melsheimer to call this worm the "Zebra." Though it does not conceal itself, it invariably curls up cut-worm fashion, and rolls to the ground when disturbed.

[Fig. 82.]



It changes to chrysalis within a rude cocoon formed just under the surface of the ground, by interweaving a few grains of sand or a

* Some of these bred specimens approach very near to *Pl. iota*, Gn. and even to *Pl. u-brevis*, Gn.

few particles of whatever soil it happens on, with silken threads. The chrysalis is ¾ of an inch in length, deep shiny brown and thickly punctured except on the posterior border of the segments and especially of those three immediately below the wing-sheaths, where it is reddish and not polished; it terminates in a blunt point ornamented with two thorns. The moth (Fig. 82, *b*,) which is called the Painted Mamestra, appears during the latter part of July, and it is a prettily marked species, the front wings being of a beautiful and rich purple-brown, blending with a delicate lighter shade of brown in the middle; the ordinary spots in the middle of the wing, with a third oval spot more or less distinctly marked behind the round one, are edged and traversed by white lines so as to appear like delicate net-work; a transverse zigzag white line, like a sprawling W is also more or less visible near the terminal border, on which border there is a series of white specks; a few white atoms are also sprinkled in other places on the wing. The hind wings are white, faintly edged with brown on the upper and outer borders. The head and thorax are of the same color as the front wings, and the body has a more grayish cast. There are two broods of this insect each year, the second brood of worms appearing in the latitude of St. Louis from the middle of August along into October, and in all probability passing the winter in the chrysalis state, though a few may issue in the fall and hybernate as moths, or may even hybernate as worms; for Mr. J. H. Parsons, of N. Y., found that some of the worms which were on his Ruta Baga leaves, stood a frost hard enough to freeze potatoes in the hill, without being killed.* I have noticed that the spring brood confines itself more especially to young cruciferous plants, such as cabbages, beets, spinach, etc., but have found the fall brood collecting in hundreds on the heads and flower-buds of asters, on the White-berry or Snow-berry (*Symphoricarpus racemosus*); on different kinds of honey-suckle, on mignonette, and on asparagus: they are also said to occur on the flowers of clover, and are quite partial to the common Lamb's-quarter or Goosefoot (*Chenopodium album*).

On account of their gregarious habit when young, they are very easily destroyed at this stage of their growth.

THE TARNISHED PLANT-BUG—*Capsus oblineatus*, Say.†

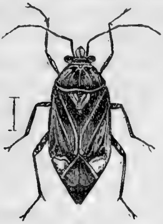
[Heteroptera Capsidæ.]

Quite early last spring while entomologizing in Southern Illinois,

* *Practical Entomologist*, II, p. 21.

† This bug was originally described by Beauvois as *Coreus linearis*, and subsequently as *Capsus oblineatus* by Say. Harris in speaking of it refers it to the sub-genus *Phytocoris* Fallen, and by mistake, changes Beauvois' specific name *linearis*, to *lineolaris*, which he translates into popular language as the "Little-lined Plant-bug." As Say's description is the only one I have access to, I have retained the name he gave it, as being eminently appropriate.

[Fig. 83.]



I spent a day with Mr. E. J. Ayres of Villa Ridge, and was surprised to learn that he had become quite discouraged in his efforts to grow young pear trees, on account of the injuries of a certain bug, which upon examination I found to be the Tarnished Plant-bug, represented enlarged at Figure 83, the hair line at its side showing the natural size. The family to which this bug belongs is the next in a natural arrangement to that which includes the notorious Chinch-bug, and the insect is, like that species, a veritable bug, and obtains its food by *sucking* and not *biting*. The *Capsus* family is a very large one, containing numerous species in this country, but among them, none but the species under consideration have thrust themselves upon public notice by their evil doings.

The Tarnished Plant-bug is a very general feeder, attacking very many kinds of herbaceous plants, such as dahlias, asters, marigolds, balsams, cabbages, potatoes, turnips, etc.; and several trees, such as apple, pear, plum, quince, cherry, etc. Its puncture seems to have a peculiarly poisonous effect, on which account, and from its great numbers, it often proves a really formidable foe. It is especially hard on young pear and quince trees, causing the tender leaves and the young shoots and twigs to turn black, as though they had been burned by fire. On old trees it is not so common, though it frequently congregates on such as are in bearing, and causes the young fruit to wither and drop. I have passed through potato fields along the Iron Mountain Railroad in May, and found almost every stalk blighted and black from the thrusts of its poisonous beak, and it is not at all surprising that this bug was some years ago actually accused of being the cause of the dreaded potato-rot.

This bug is a very variable species, the males being generally much darker than the females. The more common color of the dried cabinet specimens is a dirty yellow, variegated as in the figure with black and dark brown, and one of the most characteristic marks, is a yellow V, sometimes looking more like a Y, or indicated by three simple dots, on the scutel, (the little triangular piece on the middle of the back, behind the thorax). The color of the living specimens is much fresher, and frequently inclines to olive-green. The thorax, which is finely punctured, is always finely bordered and divided down the middle with yellow, and each of the divisions contains two broader logitudinal yellow lines, very frequently obsolete behind. The thighs always have two dark bands or rings near their tips.

As soon as vegetation starts in the spring, the mature bugs which winter over in all manner of sheltered places may be seen collecting on the various plants which have been mentioned. Early in the morning they may be found buried between the expanding leaves, and at this time they are sluggish and may be shaken down and destroyed; but as the sun gets warmer, they become more active, and

when approached, dodge from one side of the plant to the other, or else take wing and fly away. They deposit their eggs and breed on the plants, and the young and old bugs together may be noticed through most of the summer months. The young bugs are perfectly green, but in other respects do not differ from their parents except in lacking wings. They hide between the flower-petals, stems and leaves of different plants, and are not easily detected. Late in the fall, none but full grown and winged bugs are to be met with, but whether one or two generations are produced during the season I have not fully ascertained, though in all probability there are two.

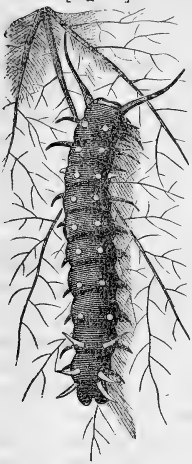
REMEDIES.—In the great majority of cases, we are enabled to counteract the injurious work of noxious insects, the moment we thoroughly comprehend their habits and peculiarities. But there are a few which almost defy our efforts. The Tarnished Plant-bug belongs to this last class, for we are almost powerless before it, from the fact that it breeds and abounds on such a great variety of plants and weeds, and that it flies so readily from one to the other. Its flight is however limited, and there can be no better prophylactic treatment than clean culture; for the principal damage is occasioned by the old bugs when they leave their winter quarters and congregate on the tender buds and leaves of young fruit stock; and the fewer weeds there are to nourish them during the summer and protect them during the winter, the fewer bugs there will be. The small birds must also be encouraged. Applications of air-slacked lime and sulphur, have been recommended to keep them off, but if any application of this kind is used, I incline to think that to be effectual, it must be of a fluid nature; and should recommend strong tobacco-water, quassia-water, vinegar, and cresylic soap. Some persons who have used the last compound have complained that it injures the plants, and every one using it should bear in mind, what was stated in the preface to my First Report, namely, that the pure acid, no matter how much diluted with water, will separate when sprinkled, and burn holes in, and discolor plant texture; while if properly used as a saponaceous wash it will have no such injurious effect. It must likewise be borne in mind, that the so-called "plant-protector" which is a soap made of this same acid, will bear very much diluting, (say one part of the soap to fifty or even one hundred parts of water) and that it will injure tender leaved plants if used too strong. I have noticed that the bugs are extremely fond of congregating upon the bright yellow flowers of the Cabbage, which, as every one knows, blooms very early in the season; and it would be advisable for persons who have been seriously troubled with this bug, and who live in a sufficiently southern latitude where the plant will not winter-kill, to let a patch of cabbages run wild and go to seed in some remote corner of the farm, in order that the bugs may be attracted thither and more readily destroyed, than when scattered over a larger area.

THE PHILENOR SWALLOW-TAIL—*Papilio philenor*, Drury.

(Lepidoptera Papilionidæ.)

There is a genus of climbing plants (the Aristolochias), which is peculiarly attractive on account of its large, rich tropical-looking foliage. The Aristolochias are represented in almost all parts of the world, and some of the tropical species bear beautiful and immense flowers. In this country we have three native species which produce but small, pipe-like flowers, but which make very pretty ornaments for covering walls and arbors or for ornamenting trellises and screens. The most common and best known species in this State is the so called Dutchman's Pipe (*Aristolochia sipho*), but the two other species (*A. serpentaria* and *A. tomentosa*) are also cultivated.

[Fig. 84.]



In the beautiful botanical grounds of Mr. Shaw, at St. Louis, there are some magnificent specimens of the Dutchman's Pipe, and about the end of last July, these had all been suddenly defoliated. I was invited to go and examine the cause and propose some remedy. I found the vines literally denuded, for there was not a whole leaf upon them, those that were not entirely eaten off down to the stem, being riddled with different sized holes. Upon a close examination, the authors of the mischief were soon found, in the shape of the peculiarly horned caterpillar, represented at Figure 84; but as there were few large specimens to be found, it was quite evident that the great bulk of them had acquired their growth, and had already left the vines for some more sheltered situation, in which to transform to the chrysalis state. There were, however, a sufficient number of smaller or more recently hatched individuals, had they remained undiscovered, to have soon taken every vestige of the few imperfect leaves remaining; while the beautiful butterflies which produced these worms were noticed flitting around the vines.

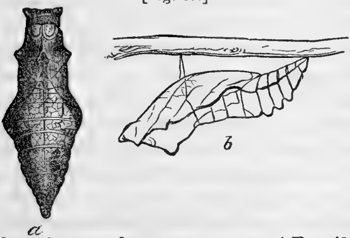
This insect is found on no other plants but the Aristolochias. The worms commence to hatch in this latitude by the beginning of July, from eggs deposited on the leaf; and individuals may be found as late as the last of August. They live in company, especially while young, and cover the leaves with zigzag lines of silk, which enable them the better to crawl about and hold on to the vines. The newly hatched worm is dark brown, with no spots, and with quite short tubercles. After the first month they become lighter colored, with the tubercles on the back of segments 6, 7, 8 and 9, of an orange color, and some of the other tubercles, especially the two on the first segment, proportionally longer than the rest. After the second

moult the color of the body becomes still lighter, some of the tubercles still proportionally longer and longer, and those on the back all begin to appear orange; while a distinct orange spot becomes visible between the long horns on the first segment, from which spot the soft, forked orange scent-organs are thrust. After the third moult but very little change takes place, and after the fourth moult, the worm loses in a great measure its shiny appearance, becomes more velvety and darker, and when full grown presents the appearance of Figure 84, and may be described as follows:

Length, two inches. Color velvety black, with a slight purplish or chesnut-brown hue. Covered with long fleshy tubercles of the same color as body, and shorter orange colored tubercles, as follows: Two, which are brown, long, tapering and feeler-like, springing anteriorly one from each side of joint 1, the two being movable, and alternately applied to the surface upon which the worm moves. Joint 2, with two brown tubercles, one springing from each side with a downward curve, and each about one-third as long as those on joint 1; also with two small dorsal, wart-like orange tubercles. Joints 3 and 5 exactly like joint 2, but on joint 4 the lateral brown tubercle is replaced by a wart-like orange one. Joints 6, 7, 8 and 9, each with two small dorsal orange tubercles, and each with a lateral, elongated, pointed, brown, downwardly curved one, arising from the base of prolegs. Joints 10 and 11 also with these lateral tubercles, but the orange dorsal ones replaced by longer pointed curved brown ones, which however often have an orange base. Joint 12 with two somewhat stouter dorsal brown tubercles, but none at sides. Joints 7, 8, 9 and 10, each with a lateral orange spot just before and above the spiracles, which are sunk into the flesh and scarcely perceptible. Head, legs, venter and cervical shield the same color as body, the venter with two tubercles on joint 5, which much resemble prolegs, the cervical shield, with an orange transverse spot on anterior edge, from which is thrust the osmaterium.

When full grown this tubercled worm fastens itself by its hind legs and by a silken loop drawn between joints 5 and 6, and in about

[Fig. 85.]

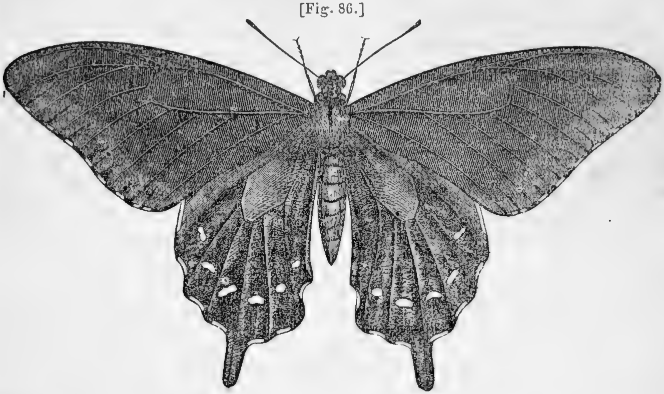


two days changes to a chrysalis, of which Figure 85, *a*, gives a shaded back-view, and *b* a lateral outline. This chrysalis is at first yellowish-green, but soon becomes beautifully marked with gray and violet, and more or less with yellow on the back: and it is readily distinguished from all other chrysalides of North American butterflies belonging to the same genus (*Papilio*) by two trigonate prominences on the head which give it a square appearance; by a very prominent trigonate projection on the top, and a lesser one each side of thorax; by the wing-sheaths being much dilated and sharply edged above, and by six prominent, rounded, narrow edged, longitudinal projections on the top of the three principal abdominal joints.

The butterfly which issues from this chrysalis in about three weeks, is such a delicate and elegant object, that it is next to impossible to give a just illustration of it. The front wings are black with a greenish metallic reflection on the nerves and along the front and hinder borders, and a row of white spots near the hinder border, which is very slightly undulate, with a narrow cream-colored mark on

the inner sinuses. The hind wings are of a brilliant steel-blue, with a greenish cast, with a carved row of white lunules and with the hinder border quite undulate and the inner sinuses cream-colored. The under surface of the front wings is more sombre than the upper surface, with the spots near the borders and the marginal lunules more distinct. The under surface of the hind wings, is on the con-

[Fig. 86.]



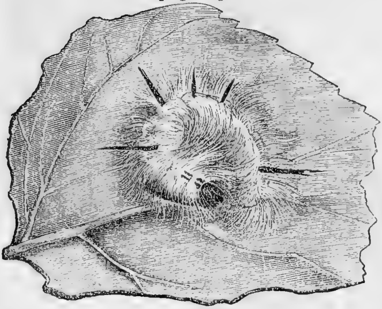
trary, with the exception of a large almost oval patch at base, of a very brilliant steel blue, with a curved row of seven rounded spots of a deep orange, bordered with black, and the four or five upper ones edged above with white; there is a small yellow basal spot, about five small whitish spots around the lower borders of the large sombre oval patch, and the marginal lunules are much more distinct than on the upper surface. The male which I illustrate (Fig. 86) differs from the female in the more brilliant hue of the upper surface, and in either entirely lacking the row of white spots near the hinder border of the front wings, or in having but the faintest trace of them.

As these Aristolochia worms are semi-gregarious, and as when young, all the individuals of a batch may be found close together, they are easily destroyed, and those persons who cultivate the Aristolochias, need never be troubled with this insect, if they will examine the vines carefully during the first half of July. The worms invariably produce butterflies during the fall months, and the insect consequently hybernates in the perfect or butterfly state. As the worms feed only on the Aristolochias, scarcely a plant of the kind can be grown without sooner or later being attacked, and the gardener should always keep a watchful eye for the worms, about the time indicated.

THE COTTONWOOD DAGGER—*Acronycta populi*, N. Sp.

(Lepidoptera Acronyctadæ.)

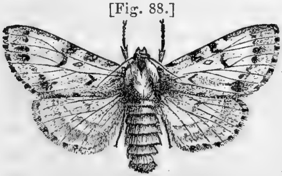
[Fig. 87.]



The Cottonwood tree (*Populus monilifera*), though not very generally cultivated in the more thickly settled parts of the country, is yet a valuable tree, especially in the newly settled parts of the West, where by its rapid growth and large foliage, it soon furnishes both wood and shade on the bleak treeless prairies. Besides several borers which eat into the trunk and root, it is attacked in this State by a very curious lazy caterpillar, which devours the foliage, and not unfrequently strips the tree.

This caterpillar (Fig. 87) when full grown, rests curled round upon the leaf, and is easily recognized by its body being covered with long soft bright yellow hairs which grow immediately from the body, part on the back, and curl round on each side. It has a shiny black head, black spots on the top of joints 1 and 2, and a straight black brush on top of joints 4, 6, 7, 8 and 11. There are two broods of these worms each year, the first brood appearing during the month of June and producing moths by the last of July, the second brood appearing the last of August and throughout September, and passing the winter in the chrysalis state. The chrysalis is dark shiny brown, and ends in an obtuse point which is furnished with several hooked bristles. It is formed within a pale yellow cocoon of silk intermingled with the hairs of the caterpillar, and is generally built in some sheltered place, such as a chink in the bark of a tree, or under the cap of some fence.

[Fig. 88.]



The moth (Fig. 88, ♀) is of a pale gray, marked with black as in the figure. It belongs to a night-flying genus (*Acronycta*) of true Owlet-moths, very closely allied to our common cut-worm moths; and yet the larvæ belonging to this genus have none of them the cut-worm habit of concealing themselves under ground, and are exceedingly heterogeneous among themselves. Some are furnished with long soft hairs like the species under consideration; some with prominent hairy warts; some have protuberances on certain segments; some are furnished with brushes; others not, etc., etc. But notwithstanding this dissimilarity among the larvæ of the genus, the moths bear very close

resemblances to one another, and in some cases it is not easy to separate them without knowing the larvæ. Our Cottonwood species has never been described. It bears a strong resemblance to several European species, but as it would only weary the general reader to give the details wherein it differs from those already described, which closely resemble it, these details will be found to accompany the scientific description below.

This insect would undoubtedly become much more numerous and troublesome, were it not for the fact that it is pursued by three distinct parasites. Many of the worms when full grown will fasten themselves firmly to a leaf in the curled position, and from the body will issue from thirty to forty little maggots. These maggots are each of them 0.17 inch long, of a dull green color, tapering each way, with a dark dorsal mark, a lateral elevated ridge, and a row of shiny elevated spots of the same color as the body between this ridge and the back. Each one spins a mass of white silk around its body, and creeps out of it and commences spinning afresh, until at last a large aggregate amount of flossy silk is spun, into which the maggots work back to transform, though some transform while lying on the surface. These maggots eventually produce a little black Ichneumon-fly belonging to the genus *Microgaster*.* Another and larger undetermed Ichneumon-fly belonging to the genus *Ophion*, also attacks this Cottonwood worm, and it is also occasionally infested with a *Tachina*-fly larva.

These worms are most easily destroyed when young, for though not strictly gregarious, they do not then scatter much from the branch upon which they were born.

ACRONYCTA POPULI, N. Sp.—*Larva*—Length 1.50. Color yellowish-green, covered with long soft bright yellow hairs which spring immediately from the body, part on the back, and curl round on each side. On top of joints 4, 6, 7, 8 and 11, a long straight double tuft of black hairs, those on 7 and 8 the smallest. Head polished black with a few white bristles. Joint 1 with a black spot above, divided longitudinally by a pale yellow line, giving it the appearance of a pair of triangles. Joint 2 with two less distinct black spots. Thoracic legs black; prolegs black with brownish extremities. Venter greenish-brown. Described from many specimens. When young of a much lighter color, or almost white, with the black tufts short but more conspicuous, with a distinct black dorsal line, two lateral purplish-brown bands, and with hairs white, sparse and straight.

Individuals vary much: some have a black dorsal line, some have but three distinct black tufts; some have a 6th tuft of black hairs on joint 9, and others have a few black hairs on all but the thoracic joints. Just before spinning up, many of the hairs are frequently lost, and the body acquires a dull livid hue.

Moth.—♀, Front wings, white, finely powdered with dark atoms which give them a very pale gray appearance; marked with black spots as follows: a complete series of small spots on posterior border extending on the fringes, one between each nerve; near the anal angle between nerves 1 and 2 a large and conspicuous spot bearing a partial resemblance to a Greek *psi*, placed sidewise, and from this spot a somewhat zigzag line running parallel with posterior border, but somewhat more arcuated towards costa, least distinct between nerves 3 and 4, and forming a large distinct dart-like spot between nerves 5 and 6; space between this line and posterior border, slightly darker than the rest of the wing-surface on account of the dark atoms being more thickly sprinkled over it; four costal marks, one subobsolete in a transverse line with the reniform spot, one conspicuous about the middle, and in a line with reniform spot and anal angle, one about the same size as the last and looking like a blurred X about one-third the length of wing from base, and one subob-

*Microgaster acronyctæ of my MS.

solet, near the base; orbicular spot flattened and well defined by a black annulation; reniform spot indicated by a blurred black mark running on the cross-vein and sometimes somewhat crescent-formed; a V-shaped spot pointing towards base half-way between costa and interior margin, in a transverse line with the large costal spot which looks like a blurred X; a blurred mark in middle at base, and lastly a narrow spot on the inferior margin, half-way between base and anal angle. Hind wings same color as front wings; somewhat more glossy, with the lunule, a band on posterior border one-fourth the width of wing, and sometimes a narrow coincident inner line, somewhat darker than the rest; the posterior border also with a series of spots one between each nerve. Under surface of front wings pearly-white with an arcuated brown band, most distinct towards costa, across the posterior one-third, all inside of this band of a faint yellowish-brown; lunule and fringe spots distinct, and with a faint trace of the *psi*-spot; hind wings uniform pearly-white with a distinct and well defined dark wavy line running parallel with posterior margin across the posterior one-third of wing, and with the lunule and fringe spots distinct. Antennæ simple and bristle-formed, gray above, brown beneath. Head thorax and body, both above and below, silvery-gray. Legs with the tarsi alternately dusky and gray. ♂ differs from ♀ by his somewhat stouter antennæ; much narrower body, and narrower wings and fringes, the front wings having the apex more acuminate, and the hind wings scarcely showing the darker hind border.

Described from 2 ♀, 2 ♂ all bred. In the ornamentation of the front wings this species bears some resemblance to the European species *tridens* and *psi*, but otherwise differs remarkably, and especially in its larval characters. It bears a still closer resemblance both in the larva and imago state to the pale variety of a common species known in England as the "Miller" (*A. leporina*), but judging from the figures and description in "Newman's Natural History of British Moths," it may be easily distinguished from *leporina* by the well defined orbicular spot, by the greater proximity of the two large costal spots, by lacking a round spot behind the disk, and by the more prolonged apex. It differs also in the larva state from *leporina* which feeds on the Birch. It likewise closely resembles *interrupta*, though the larvæ are remarkably different; and it also resembles *lepusculina*, the larva of which is unknown; but the specific differences will be readily perceived upon comparing Guenée's descriptions. How near it approaches to *Acronycta occidentalis*, Grote,* it is impossible to tell, as the author's description is exceedingly brief, considering the number of closely allied forms; but as that species has a bright testaceous tinge on the reniform spot, it evidently differs from mine. Harris's *Apatela* [*Acronycta*] *Americana*,† though very different in the imago, yet closely resembles *populi* in the larva state. I have on two occasions found the larva of *Americana* feeding on the Soft Maple, and it may be distinguished from *populi*, by its greater size; by the paler color of the body; by the hairs being paler, more numerous, shorter and pointing in all directions, especially anteriorly and posteriorly of each segment; by having on each of joints 4 and 6 two distinct long black pencils, one originating each side of dorsum, and on joints 11 one thicker one originating from the top of dorsum; by a substigmatal row of small black spots (three to each segment, the middle one lower than the others) and by a trapezoidal velvety black patch starting from anterior portion of joint 11 and widening to anus.

THE MISSOURI BEE-KILLER—*Asilus Missouriensis*, N. Sp.

(Diptera Asilidæ.)

On page 168 of my First Report an account is given, with a very poor figure, of a large two-winged fly which was first received by Dr.

*Proc. Ent. Soc. Phil., VI, p. 16.

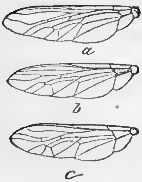
†I am surprised that Dr. Morris (*Harr. Inj. Insects*, p. 436, Note) refers this species to Guenée's *acericola*, when the larva of the latter, as described by Guenée himself, is so different and feeds withal on Birch and Alder, and not on either Maple, Elm, Linden or Chesnut.

[Fig. 89.]

Fitch, of New York, from Mr. R. O. Thompson of this State, who found that it had the pernicious habit of catching and sucking out the juices of the common honey-bee. Dr. Fitch referred this fly to the genus *Trupanea*, and called it the Nebraska bee-killer, from its having first been captured by Mr. Thompson in Nebraska, where he at that time resided. The great German Dipterist, H. Loew, as I am informed by Baron Osten Sacken of New York, ignores and has discontinued the genus *Trupanea*, substituting in its place that of *Promachus*; and Fitch's *Trupanea apivora* is the very same species previously described by Loew as *Promachus Bastardii*, and it is one of the most common species, occurring very generally over the United States.

I find that we have in Missouri a somewhat larger fly (Fig. 89) which has the same pernicious habit of seizing and destroying the honey-bee in preference to all other kinds of prey. It acts in exactly the same manner as the Nebraska Bee-killer, being, if anything, more inhuman and savage. It belongs to the typical genus *Asilus*, and I have called it the Missouri Bee-killer (*Asilus Missouriensis*). Though bearing a casual resemblance to the Nebraska Bee-killer, it may very readily be distinguished from that species, and especially by the different venation of the wings.

[Fig. 90.]



The three more common genera of these voracious *Asilus* flies, may easily be distinguished from each other by the character of these wing-nerves. In the typical genus *Asilus* to which belongs our Missouri Bee-killer, the *third* longitudinal vein is forked near the terminal *third* of the wing, and the vein itself is connected about the middle of the wing, with the fourth longitudinal, as in Figure 90, *b*. In the genus *Promachus*, to which the Nebraska Bee-killer belongs, it is the *second* (not the third) longitudinal vein which is forked near the *middle* of the wing, and the third branch of this fork is connected by a slender cross-vein to the third longitudinal, near the terminal third of the wing, as in Figure 90, *a*. In the genus *Erax*, which generally comprises smaller species, the venation is similar to that of *Asilus*, but the upper branch of the fork, instead of joining the third longitudinal vein, is abruptly broken off and connected only near its termination by a transverse vein, as in Figure 90, *c*.

Asilus Missouriensis N. Sp.—Alar expanse 1.85; length of body 1.30 inches. *Wings* transparent, with a smoky yellow tinge, more distinct around the veins, which are brown. *Head* pale yellow, sometimes brownish; moustache straw-yellow with a few stiff black hairs below; beard pale straw-yellow; crown very deeply excavated; base of the same pale yellow with short, stiff,

yellowish hairs, and a crown of black ones near the border; eyes large, prominent, finely reticulated and almost black; antennæ, first joint black tipped with brown, cylindrical and hairy; second joint black, short, thick and rounded at tip, with a few stiff hairs; third joint as long as first, tapering each way, smooth, black and terminating in a long, brown bristle; proboscis black and nearly as long as face; neck with pale and black hairs. *Thorax* leaden-black, slightly opalescent with reddish brown at sides, more or less pubescent with pale yellow, especially laterally and posteriorly and in three narrow longitudinal dorsal lines which gradually approach towards metathorax; bearded at sides and behind with a few decurved black bristles, those behind interspersed with a few smaller pale hairs; scutel of the same color, with upward-curving, black bristles; halteres brown. *Abdomen*, ♂, general color dull leaden-yellow, with darker transverse bands at insections; the light color produced by a yellowish pubescence and numerous short close-lying yellow hairs, the dark bands produced by the absence of this covering at the borders of each segment; basal segment broad, bilobed, and with lateral black bristles; segments 6, 7, 8 and anal valves with a decided pink tint, especially 7; 8 but one-third as long as 7 above. ♀, broader, flatter, more polished and brassy, with no transverse darker bands, segments 7 and 8 polished black, the latter narrow and longer than any of the others; anus with a few black bristles. *Legs*, dull purple-brown, with black bristles; thighs very stout, the hind pair rather darker than the others, the two front pair of trochanters with long, yellowish hairs; pulvilli, generally fulvous.

Described from two ♂, and two ♀, all captured while sucking honey-bees. I have not access to Loew's descriptions, and cannot therefore compare it with already described species; but specimens have been sent to Dr. Wm. LeBaron, of Geneva, Illinois, and to Baron Osten Sacken, of New York, and both these gentlemen are unacquainted with it, and believe it to be new. In the well marked ♂ specimens, the body bears a general resemblance to that of *Trupanea* [*Promachus*] *vertebrata*, Say.

Of course the apiarian will care very little to know which of these two Bee-killers is weakening his swarms. They should both be unmercifully destroyed, and though very strong and rapid flyers, they may be easily caught when they have settled on any little prominence with a bee in their grasp; for they are so greedy of the bee's juices that they are at this time less wary, and even when disturbed, will fly but a few yards away before settling again. A net such as that described in the article on "Cabbage worms" will be found useful in catching these mischievous flies.

The habits and preparatory stages of our *Asilus* flies are not very well known. They are all cannibals in the fly state, sucking out the juices of their victims with the strong proboscis with which they are furnished, and by which they are capable of inflicting a sharp sting on the human hand. The larvæ are footless, and live in the ground, and such as are known in this state are strangely enough, vegetable-feeders.

[Fig. 91.]

The only N. A. species that has heretofore been bred to the perfect state, is the Silky Asilus (*Asilus sericeus*, Say., Fig. 91) belonging to the typical genus *Asilus*. Its larva feeds upon the roots of the Rhubarb, and was bred to the perfect state by Dr. Harris (*Inj. Insects*, p. 605). I have succeeded in breeding to the fly state another species, belonging however to the genus *Erax*, and subjoin a description of the larva, as it is of considerable scientific interest. The fly is figured below (Fig. 93 *a*).

[Fig. 92.]

Erax Bastardi (?)—*Larva*—(See Fig. 92.) Length 1.05 inches. Only twelve joints, the three anterior and the three posterior ones tapering gradually, the rest of equal width; slightly depressed; translucent yellowish-white, the chitinous covering tolerably firm however; a swollen lateral ridge; two rufous dorsal spiracles on joint 1 and two similar ones on joint 11. Head dark brown, very retractile, pointed, divided at tip into two mandibulate points, and having two unguiform appendages; anal segment with two depressed longitudinal lines above, ridged on anterior edge and with a central depressed line below. It makes use of its head in crawling.

Pupa—(Fig. 93 *b*). Stout, honey-yellow; the leg and wing-sheaths soldered together though separated from the abdomen; eyes large and dark; head with two large brown spines in front, and a lateral set of three rather smaller ones; thorax with two small thin rounded dorsal projections and a set of two small lateral spines just behind the head; abdomen, with each segment ridged in the middle and furnished on this ridge with a ring of brown blunt thorns sloping backwards; anal segment with a few rather stouter spines.

[Fig. 93.]

a *b*

Two specimens, one found by Mr. G. C. Brodhead of Pleasant Hill, Mo., under a peach tree, the other by Mr. G. Pauls of Eureka, Mo., under a "creeping vine" of which he did not know the name. They were found full grown in May, and gave out the flies the fore part of July. Both produced ♀♀, on which account the species cannot be determined with absolute certainty. Osten Sacken informs me that it is allied to *tabescens* Loew, but is different. It is marked *lictor* in my MS., but from Macquart's description of *Bastardi*, and from ♂ and ♀ specimens of that species kindly furnished by Dr. Le Baron, I feel pretty confident that it is ♀ of that species, which is described as follows: *Abdominis segmentis tribus apicalibus niveus* ♂; *omnibus segmentis albido marginatis* ♀. *Pedibus nigris: tibiis rufis: alis flavidis. Long.* 7½ l. He then adds: "Face and front black with gray down; moustache with the upper half black and lower half white; as also the beard. The middle band of thorax divided. The first four segments of the abdomen with the posterior and lateral borders whitish. Extremities of the legs black. From North America. From 3 ♂, I have seen one which had the four terminal segments of the abdomen white." My females accord very well with this description so far as it goes, though I cannot see why Macquart restricts the whitish borders to the first four segments in the French description, when in the Latin it is stated that all the segments are so bordered, which is the case with my specimens.

INNOXIOUS INSECTS.

THE GOAT-WEED BUTTERFLY—*Paphia glycerium*, Doubleday.

[Lepidoptera, Nymphalidæ.]

[Fig. 94.]

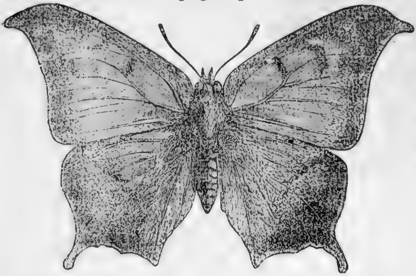
There is is an interesting and rare butterfly known to entomologists by the name of *Paphia glycerium*, which occurs in Missouri, Texas and Illinois, and perhaps in other southwestern States. It is an interesting species on account of the dissimilarity of the sexes, and of the position it holds among the butterflies; and as its natural history was unknown till the present year, I will transcribe from the *American Entomologist*, the following account of it, which I was enabled to prepare from specimens kindly sent to me last September by Mr. J. R. Muhleman, of Woodburn, Ills., and from further facts communicated by Mr. L. K. Hayhurst, of Sedalia, Mo.

Dr. Morris, in his "Synopsis of the Lepidoptera of North America," places this butterfly with the *Nymphalis* family, of which the Disippus Butterfly (*Nymphalis disippus*, Godt.), is representative. The larva, however, has more the form and habits of that of the Tityrus Skipper (genus *Goniloba*), while singularly enough, the chrysalis resembles that of the Archippus Butterfly (genus *Danais*).

The larva feeds on an annual (*Croton capitatum*) which is tolerably common in Missouri, Illinois, Kentucky, and westward, where it is known by the name of Goat-weed, and as no value whatever is at-

tached to it, the insect which attacks it cannot be classed among the injurious species. The plant has a peculiar wooly or hairy whitish-green appearance, and in the month of September its leaves may frequently be found rolled up after the fashion shown at the left of Figure 94, with the larva inside. This roll of the leaf is generally quite uniform, and is made in the following manner: Extending itself on the midvein, with its head towards the base of the leaf, the larva attaches a thread to the edge, at about one-fourth the distance from the base to the point. By a tension on this thread, it draws this edge partly toward the opposite one, and fastens it there, being assisted in the operation by the natural tendency of the leaf to curl its edges inwards. Fastening a thread here, it repeats the operation until the edges meet, and then it proceeds to firmly join them nearly to the apex, leaving a small aperture through which to pass the excrement. During hot days the larva remains concealed in the leaf, and towards evening comes out to feed, though sometimes it feeds upon its house, eating the leaf down half way from base to point. It then abandons it and rolls up a new one. In the breeding cage, when placed in a cool shady room, the larva seldom rolls up the leaves, but feeds at random over the plant, and when at rest simply remains extended on a leaf. From this we may infer that its object in rolling the leaves is to shield itself from the rays of the hot August and September sun; for the plant invariably grows on high naked prairies.

[Fig. 95.]

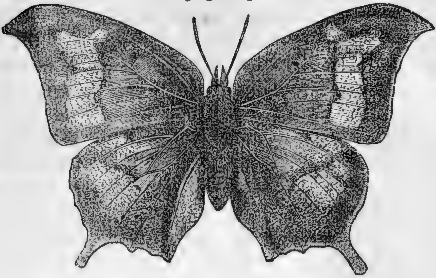


The young larva has a large head, larger than the third segment, which is the largest in the body. The head preserves its general form through the successive moults; it is light bluish, thickly covered with papillæ of a dirty-white color, and there are also a number of light orange papillæ of a larger size scattered among them. The skin of the caterpillar is *green*, but the general hue is a dirty-white, owing to the entire surface being very closely studded with white or whitish papillæ with dark-brown ones interspersed. These prominences are hemispherical, hard, opaque, shining, and the larva feels rough and harsh to the touch.

At each moult some of these papillæ disappear, especially *all* the brown ones, the body increases in size so that the head is smaller than the third segment, the green color of the skin becomes more apparent, the body is softer to the touch, and the whole larva assumes a neater appearance.

Thus this larva has very much the same peculiar whitish glaucous-green color as the plant on which it feeds; and any one who has seen it upon the plant, cannot help concluding that it furnishes another instance of that mimickry in Nature, where an insect, by wearing the exact colors of the plant upon which it feeds, is enabled the better to escape the sharp eyes af its natural enemies. When full-grown, which is in about three weeks after hatching, this worm (Fig. 94, *a*) measures $1\frac{1}{2}$ inches, and although, as above described, the little elevations frequently disappear so that it looks quite smooth, yet sometimes they remain until the transformation to chrysalis takes place, as was the case with two which I bred.

[Fig. 96.]



PAPHIA GLYCERIUM.—*Full-grown larva*—Length 1.50 inches. Cylindrical. General appearance shagreened, pale glaucous-green, lighter above stigmata than elsewhere. Ground-color, of body clear green. Thickly covered with white papillæ or granulations, which are often interspersed with minute black or dark-brown sunken dots. Head quite large, (rather more than $\frac{1}{2}$ as large as the third segment), nutant, subquadrate, bilobed, granulated like the body, but with the black sunken dots more numerous, and having besides, several larger granulations above, some four of which are generally black and the rest fulvous; a row of three very distinct eye-spots at the base of palpi; the triangular V-shaped piece elongated and well defined by a fine black line, and divided longitudinally by a straight black line; palpi and labrum pale. the latter large and conspicuous; jaws black. Neck narrow, constricted, green, smooth, and retractile within first segment. Segments 1—3 gradually larger and larger; 3 to last gradually smaller. Stigmata fulvous. Venter less thickly granulated than tergum. Described from five full-grown specimens received from Mr. Muhleman.

Preparatory to transforming, it suspends itself by the hind-legs to a little tuft of silk which it had previously spun, and after resting for about twenty-four hours with its head curled up to near the tail. it works off the larval skin and becomes a chrysalis, which in from two to three weeks afterwards gives out the butterfly. This chrysalis (Fig. 94, *b*) is short, thick, rounded, and of a light green; sometimes becoming light gray, and being finely speckled and banded with dark gray. The skin is so thin and delicate that the colors of the butterfly may be distinctly seen a few days before it makes its escape.

The male butterfly (Fig. 95), is of a deep coppery-red on the upper side, bordered and powdered and marked with dark purplish-brown, as shown in the figure. The under side is of a *feuille morte* brown with a greasy lustre, the scales being beautifully shingled transversely so as to remind one of that article of dry-goods which the ladies call rep; while the bands which commenced on the front wings above, may be traced further across the wing, and there is a transverse band on the hind wings, with an indistinct white spot near

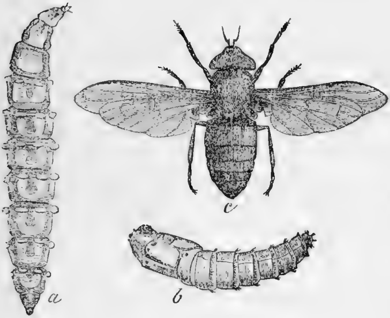
the upper edge. The female (Fig. 96), is of a lighter color than the male, marked with purplish-brown as in the figure, the transverse bands being quite distinctly defined with very dark-brown. The under side is very much as in the male.

A few of the butterflies, in all probability, manage to live through the winter, and are thus enabled to perpetuate the race, by depositing their eggs, the following summer, on the leaves and stems of the Goat-weed, which is the only plant upon which the insect is yet known to subsist.

THE BLACK BREEZE-FLY—*Tabanus atratus*, Fabr.

(Diptera, Tabanidæ.)

[Fig. 97.]



There is a family of large Two-winged Flies, commonly called Breeze-flies in England, but more commonly known as Horse-flies in this country, the insects belonging to which are, in the perfect state, great nuisances, though there is every reason to believe that as larvæ they are beneficial to the husbandman, by devouring many noxious underground vegetable-feeding larvæ.

This family comprises some of the very largest flies, and they are all noted for the tormenting powers which the female has of piercing the skin and sucking the blood of different quadrupeds and even of man. They are widely distributed, and species occur in all parts of the world, torturing alike the huge elephant and fierce lion of the tropics, and the peaceful reindeer of the arctic region. It is during the hottest summer months that they "do most abound," and they frequent both our timbered and prairie regions. One of the most common species in the West is the so-called "Green-head Fly" (*Tabanus lineola*, Fabr.) and every farmer who has to work on the prairies, especially during the hay-making season, knows how blood-thirsty it is, and how absolutely necessary it is to cover the horses at this season of the year, in order that they may be able to work at all. Two other species of nearly the same size (*T. costalis*, Wied. and *T. cinctus*, Fabr.) are common with us, and I have found the striped

Chrysops (*Chrysops vittatus*, Wied.)—a smaller yellow species with black stripes, and a broad smoky band across the middle of each wing; to be very troublesome in our wooded regions, confining its attacks more especially to the horses' ears, from which habit it is frequently called the "Ear-fly."

It is only the female flies, as is the case also with our mosquitoes, which thus torment our animals by means of their sharp lances, the males living on the sweets of flowers, and their mouths being destitute of mandibles. The flight of these Breeze-flies is very strong and rapid, and is attended with a buzzing, tormenting noise. The males may often be seen with the wings vibrating so rapidly that they become invisible, resting motionless in one place, and then darting rapidly and resting suddenly again, generally turning the head in some other direction each time they dart; and St. Fargeau has ascertained that this manœuvering is performed in order to intercept and seize the females.

Although these flies swarm so prodigiously on our prairie and especially on our low swampy lands, yet hitherto very little has been known of their larval character and habits. De Geer very many years ago described the larva of the European Cattle Breeze-fly (*Tabanus bovinus*, Linn.), and up to 1864 this was the only larva of the kind known. In February of that year Mr. Walsh published the description of another Tabanide larva, but without being able to refer it to any particular species.* I had the good fortune last summer to breed to the perfect state the very same kind of larva which Mr. Walsh described. It proved to be one of our most common and largest species, namely The Black Breeze-fly (*Tabanus atratus*, Fabr.) This Fly (Fig. 97, *c*) is black, the back of the abdomen being covered with a bluish-white bloom like that on a plum; the eyes are large, and the wings are smoky dark brown or black.

The larva (Fig. 97, *a*) is a large 12-jointed, cylindrical affair, tapering at each end, of a transparent, highly polished, glassy, yellowish or greenish appearance, shaded with bluish-green and furnished above and below, as in the figure, with large roundish sponge-like tubercles which are retracted or exserted at the will of the insect. Though the external integument is so transparent, that the internal structure is readily visible, yet this integument is firm and the larva is most vigorous and active, burrowing with great strength either backwards or forwards in the earth, and between one's fingers while it is being held. Placed in water it will swim vigorously by suddenly curling round and lashing out its tail, but it is apparently not as much at home in this element as in the wet earth, for it is restless and remains near the surface, with the tip of the tail elevated in the air. When the water is foul it moves about actively near the surface, but when it is fresh it remains more

*Proc. Bost. Soc. Nat. Hist., Vol. IX, pp. 302-6.

quiet at the bottom. The specimen which I succeeded in breeding, was sent to me by Mr. Adolph Engelmann of Shiloh, St. Clair Co., Ills. It was found by Mr. Wm. Cooper of the same county, about ten feet from a small but permanent stream of water. Mr. C. at first took it to be a leech, and when he attempted to capture it, it immediately commenced burrowing in the ground.

Mr. Walsh's description of this larva is so full, and agrees so well with mine, that I cannot do better than transcribe it.

TABANUS ATRATUS.—*Larva,*—Length 2.25 inches when extended, 1.75 inches when contracted ; diameter .25—.30 inch. Body cylindrical, 12-jointed, the three or four terminal joints much tapered at each end of the body, but more so anteriorly than posteriorly, and joints 1 and 11, each with a retractile membranous prolongation at tip. Joints 1 to 10 are subequal ; 11 is about two-thirds as long as 10 and 12 about one-fourth as long, and .05 inch in diameter. [Joints 1 and 12 pear-shaped when extended]. Color a transparent greenish-white, paler beneath ; an irregular dark-green or greenish-black annulus, paler beneath, on the anterior and posterior margins of joints 2 to 11, the anterior annulus laterally connected with the posterior by two to four dark-green lines. On the dorsum of 4 to 9, and more obscurely on 10, a dark-green basal triangle, extending half-way to the tip ; joint 1 with paler markings, and with no dark annulus behind ; joint 12 entirely fuscous. Head small, apparently fleshy, pale, truncate-conical, .03 inch wide, and about .04 inch long in repose, inserted in joint 1 without any shoulder. The trophi occupy two-thirds of its length, but it has a long cylindrical internal prolongation, extending to the middle of joint 2, which is sometimes partially exserted, so that the head becomes twice as long as before. All the trophi are pale and apparently fleshy, except the mandibles, which are dark-colored and evidently horny, and they have no perceptible motion in the living insect. The lubrum is slender, a little tapered, and three times as long as wide, on each side of and beneath which is a slender, thorn-like, decurved, brown-black mandible. The labium resembles the labrum, but is shorter, and on each side of it is a slender palpiform, but exarticulate maxilla, extending beyond the rest of the mouth in an oblique direction. No palpi. On the vertex are a pair of short, fleshy, exarticulate, filiform antennæ, and there are no distinct eyes or ocelli. In the cast larval integument the entire head, .25 inch long, is exserted, and is dark-colored and evidently horny, all the parts retaining their shape except the antennæ, labrum and labium. The whole head has here the appearance of the basal part of the leaf of a grass-plant, clasping the origin of the maxillæ on its posterior half, and bifurcating into the somewhat tapered cylindrical mandibles on its anterior half. The maxillæ are traceable to two-thirds of the distance from the tip to the base of the head, scarcely tapering, bent obliquely downwards at two-thirds of the way to their tip, and obliquely truncate at tip. On the anterior margin of ventral segments 4—10, in the living insect, is a row of six large, fleshy, roundish, tubercular, retractile pseudopods, the outside ones projecting laterally, and each at tip transversely striate and armed with short, bristly pubescence ; on the anterior half of ventral joint 11 is a very large, transversely-oval, fleshy, whitish, retractile proleg, with a deeply impressed, longitudinal stria. On the anterior margin of dorsal joints 4—10, is a pair of smaller, transversely-elongate, retractile, fleshy tubercles, covering nearly their entire width, armed like the pseudopods, but not so much elevated as they are. No appearance of any spiracles. Anus terminal, vertically slit with a slender, retractile thorn .05 inch long, not visible in one specimen. Head, and first segment or two, retractile.

The larva reared by De Geer was terrestrial. This larva is semi-acquatic, for it is quite at home either in water or moist earth. My specimen was kept for over two weeks in a large earthen jar of moist earth well supplied with earth-worms. It manifested no desire to come to the surface, but burrowed in every direction below. I found several pale dead worms in the jar, though I cannot say positively whether they had been killed and sucked by this larva. Mr. Walsh in speaking of its haunts and of its food, says: "I have, on many different occasions, found this larva amongst floating rejectamenta. On one occasion I found six or seven specimens in the interior of a floating log, so soft and rotten that it could be cut like

cheese. Once I discovered a single specimen under a flat, submerged stone, in a little running brook. And finally, I once met with one alive, under a log, on a piece of dry land which had been submerged two or three weeks before, whence it appears that it can exist a long time out of the water. I had, on several previous occasions, failed to breed this larva to maturity, and the only imago I have, was obtained in 1861, from larvæ, which, suspecting them to be carnivorous from the very varied stations in which they had occurred, I had supplied with a number of fresh-water mollusks, but the habits of which, in consequence of having been away from home, I was unable to watch. On September 2d, 1863, I found a nearly full-grown larva amongst floating rejectamenta, and between that date and September 23d, he had devoured the mollusks of eleven univalves (*Gen. Planorbis*) from one-half to three-fourths of an inch in diameter; and on three separate occasions I have seen him work his way into the mouth of the shell. In this operation his pseudopods were energetically employed, and I found, on cracking the shells after he had withdrawn, that a small portion of the tail end of the animal was left untouched—no doubt in consequence of his being unable to penetrate to the small end of the whorl of the shell—and also the skin of the remaining part, and the horny-tongued membrane."

My larva transformed to pupa (Fig. 97, *b*) within the ground, during the fore part of July; it remained in this state but a few days, and the fly issued July 13th, and soon made its presence known by its loud buzzing inside the jar. It was a perfect ♀ specimen, and the pupal integument was sufficiently firm and polished, that by carefully washing off the earth, an excellent cabinet specimen was obtained, which retained almost the exact form and appearance of the living pupa. Before the escape of the fly which was effected through a longitudinal fissure on the back of the head and thorax, reminding one of the mode of escape of our Harvest-flies (*Cicadæ*), this pupa by means of the thorns with which it is furnished, had pushed itself up to the surface of the earth. My specimen being female, may account for the very slight difference between the following description and that of Mr. Walsh's.

Pupa, (described from pupal integument).—Cylindrical, lying curved as in the figure; rounded at the head, and tapering at the last two joints; pale semi-transparent yellowish-brown. *Head* with two transverse, narrow-edged, somewhat crescent-shaped dark-brown projections representing the mouth, two rounded tubercles above, on the front, of the same color, and each giving out a stiff bristle; and midway between these four, two much smaller, lighter, rounded tubercles, set closer together; on each side in a line with the upper tubercles, a wrinkled antenna, trigonate at base, appressed to the surface and pointing outwards; below these antennæ, on the eyes, two small bristled warts. *Thorax*, pronotum commencing behind antennæ, with a pair of small bristled brown tubercles* on its anterior dorsal submargin; mesonotum twice as long as pronotum, with a pair of large obliquely-placed, reniform, purple-brown tubercular spiracles, bordered on the outside above, with a distinct fine white line; between these spiracles are four small brown elevations the two middle ones quite small and close together; a short metanotal piece, about one-seventh as long

*Evidently not spiracles as Mr. Walsh supposed. The mesonotal spiracles are well defined, with the white border above mentioned, and the abdominal spiracles are each marked behind by a distinct white line; but these tubercles have no such annulus and are illy defined.

as pronotum and without spiracles. *Abdomen*, with 8 subequal segments, with two well defined lateral impressed lines, and all but the last bearing between these lines, a rounded brown tubercular spiracle, the posterior upper borders lined with white. The first segment is simple and extends to the tips of the wing-sheaths; the others are all furnished, on the posterior one-third, with an annulus of fine, yellowish bristles, depressed and directed backwards. Anal thorn robust, yellow, truncated, and furnished with six stout brown thorns, hexagonally arranged. Length 1.20 inches; greatest diameter 0.30 inch. One ♀ specimen.

This large Black Breeze-fly does not attack horses to any considerable extent that I am aware of, but is said to bite cattle. The smaller species of real Horse-flies mentioned above, and which occur in prodigious numbers on our Western prairies, away from any large streams of water, must evidently be terrestrial in the larva state, and not aquatic, and must just as surely live on other food than snails, which are quite rare on the prairies. They are certainly carnivorous however, and it is but natural to suppose that they feed on underground vegetable–feeding larvæ, such as the different kinds of white grubs, the larvæ of Crane-flies (*Tipulidæ*), etc. Thus, in all probability, they perform a most important part in the economy of Nature, by checking the increase of those underground larvæ which are the most unmanageable of the farmer's foes. They therefore partly atone for the savage and blood-thirsty character of the perfect females, and I prefer consequently to place them with the other Innoxious Insects.

GALLS MADE BY MOTHS.

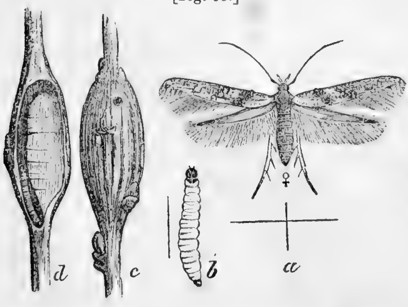
As a sequence to the article on the Solidago Gall Moth (*Gelechia gallæsolidaginis*, Riley) published in my former Report, I will here describe two other gall-making moths, with which I was not then acquainted, the first of which, as I have since ascertained, occurs in this State. The other I have never yet met with.

THE FALSE INDIGO GALL-MOTH—*Walshia amorphella*, Clemens.

(Lepidoptera, Tineidæ.)

On the leafless stems of the False Indigo (*Amorpha fruticosa*) may often be seen, during the fall, winter and spring months, an elongated swelling such as that shown at Figure 98, *c*, two of them often occurring one above the other. This swelling is a simple enlargement of the stem to five or six times its natural diameter, and measures from three-quarters of an inch to an inch in length. If cut open during any of the winter months, the interior will present a tough woody appearance, with an irregular brown channel, almost always

[Fig. 98.]



at one side of the gall, and communicating above with a small closed-up tubercle (See Fig. 98, *d*,). At the bottom of this channel the larva (Fig. 98, *b*, enlarged), which is whitish with a conspicuous black head and black collar, may always be found, and it does not transform to the chrysalis state till a few weeks before appearing as a moth. The tubercle near the top of the gall is evidently caused by the young larva penetrating the stem when it first hatches out; and this larva must, after it has burrowed the proper length down the stem, turn round and widen the burrow right up to the point of entrance; for it is from this point that the moth escapes in the spring. The moth, of which Figure 98, *a*, represents an enlarged female, is easily distinguished from most other small moths belonging to the same family (*Tineidæ*) by its beautifully tufted front wings, which are not easily represented in a wood-cut. It is of a yellowish-brown color, marked with darker brown, and the males are generally a little darker than the females. This little moth was first described by Clemens (Proc. Ent. Soc. Phil., Vol. II, p. 419), who named the genus in honor of Mr. Walsh, its first discoverer, and so far as I am aware it is the only representative of the genus.

The twigs invariably wither and dry up above this gall, but as the shrub has no particular value, the little gall-maker may be placed among the harmless insects.

WALSHIA AMORPHELLA—*Larva*—Length 0.35—0.40 inch. Cylindrical, tapering each way, but more especially towards anus. Yellowish-white, each segment with about two distinct transverse folds. Two dorsal rows of pale but polished piliferous spots, two to each segment; stigmata round, jet black with a white centre, with a pale piliferous spot above, and two contiguous ones on a lateral fold, below each; on joints 1 and 2 the folds are more numerous and the piliferous spots are larger and arranged in a transverse row. Head either black or dark brown, the trophi except the maxillæ white, and the eyelets, arranged in a crescent, also pale. Cervical shield same color as head, divided in the middle by a distinct pale line. Both have a few white hairs, arising from pale points. Anal shield small and brown. Thoracic legs pale but slightly horny, transparent, furnished with hairs, and with two basal semi-circular brown lines behind, the largest terminating on the inside, in a black thorn. Prolegs very small and scarcely distinguishable except by a faint brown circular rim at extremities, and a still fainter one at their base. Described from numerous specimens, all very uniform.

Pupa—Unknown.

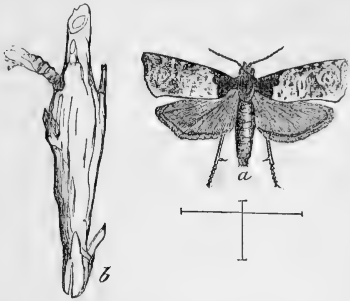
Moth—Front wings yellowish-fuscous, with a rather large blackish brown patch at the base of the wing, somewhat varied with spots of the general hue, and a blackish-brown tuft, having the scales directed toward the tip of the wing, on the basal third of the fold, and a smaller one above it near the costa. Near the end of the fold is another small tuft of the general hue, having the ends of the scales tipped with dark brown, and in the middle of the wing nearly adjoining the latter is a large tuft of the general hue. Above the end of the fold is a small blackish-brown tuft, the scales of which are not so much erected as in the other tufts; between this and the central tufts is a blackish-brown patch which sends a streak of the same hue into the fold. The apical portion of the wing is somewhat discolored with brown, and along the inner margin, at the base of the cilia, are five or six black dots. Cilia dull testaceous. [Hind wings shiny yellowish-brown, long, narrow, lanceolate, with very long cilia] Antennæ fuscous [the basal joint long, smooth and clavate]. Head and thorax blackish-brown; labial palpi yellowish-fuscous. [Abdomen above dark brown, the joints bordered behind with gray, the terminal joint with a yellow tuft. Legs short, the tarsi only of hind pair reaching beyond abdomen; marked with gray and brown. Under surface uniform grayish-brown, the hind wings somewhat paler, and all the wings bordered with a paler line. Length 0.20; alar expanse 0.53 inch.] (After Clemens).

THE MISNAMED GALL-MOTH—*Euryptychia, saligneana*, Clemens.

(Lepidoptera, Tortricidæ.)

The only other gall-producing moth known in this country is the species illustrated herewith (Fig. 99, *a*), and there are some doubts in my mind as to whether it is a real gall-maker or an "inquiline" or intruder on my true Solidago Gall-maker (*Gelechia gallæsolidaginis.*) But two specimens of the moth have ever been found, one of which is in the cabinet of the late Brackenridge Clemens, at Philadelphia, and the other in my possession. They were both bred by Mr. Walsh from golden rod galls resembling those of my Solidago gall in being elongated and hollow; and from specimens kindly furnished to me before his death, I am enabled to give the above sketch of the dried gall, with the pupa-skin attached, and likewise that of the moth. The only description which exists of the larva is of a dead and somewhat shrunken specimen, in the following brief note taken from Mr. Walsh's journal: "Larva 16-footed, yellowish; spiracles (fuscous) on all but 2d, 3d and anal segments. Head and 2d [1st] segment horny and rufous. Length 0.40."

[Fig. 99.]



The moth is the only representative of its genus (*Euryptychia*) so far known. It was described in 1865 by Dr. Clemens * as *E. saligneana*, under the false impression that it was reared from a willow gall. But the scientific name of the insect must stand, however inappropriate.

EURYPTYCHIA SALIGNEANA—*Moth*—Front wings white, tinted with yellowish. The basal patch is dark brown. The wing beyond the basal patch is nearly white, varied with leaden-colored speckles and striped over the nervules with dull, leaden-gray, transverse stripes, two of which near the anal angle form a white ocelloid patch. Immediately interior to the ocelloid patch is a small black spot, having a line of black atoms running into it, from above and beneath. Below the apex, on the hind margin, is a triangular brown patch, which is varied with grayish and dotted with black in the middle and along the inner edge. The costa is geminated with white, and striped with brown. Hind wings dark fuscous. (After Clemens.)

Generic character—Hind wings broader than front wings. Costal and subcostal veins with a common origin; branches of subcostal connivent. Median vein 4-branched, three of which are aggregated, the two central ones from a common base. Front wings *with a broad fold,* extending to the middle of the costa, closely appressed; at least three times longer than broad; costa straight, tip moderately acute, apical margin rounded. The nervules given off from the posterior end of the cell are bent toward each other or are somewhat aggregated.

Head smooth, with ocelli at base of antennæ. Antennæ filiform, simple. Labial palpi, *do not exceed the face,* are curved, smooth, rather slender, expanded toward the tip, the apical joint scarcely perceptible, except in front. (Clemens.)

My reasons for thinking this insect an intruder on the rightful gall-maker, are: 1st, because if it were a true gall-maker we should

* Proc. Ent. Soc., Phil., V., p. 141.

naturally expect to find its gall more common; 2d, because on several occasions I have found within the *Gelechia* gall, a pale worm very different from the true gray gall-making larva. But until more decided proof can be obtained, and until the fact is settled by further experience and experiment, we must, from such evidence as we have, consider the Misnamed Gall-moth, a true gall-maker.

Thus we have three different and distinct gall-moths in this country, belonging to two distinct families and three distinct genera; while a fourth (*Cochylis hilarana*) belonging to still another genus is known to form a gall on the stems of *Artemisia* in Europe. It is very manifest that all of these galls are formed by the irritating gnawings of the larva after it is hatched, and not induced by any poisonous fluid injected with the egg by the ovipositor of the parent, as is demonstrably the case with those galls which are produced by gall-flies (*Cynips* family), and with such as are produced by some gall-making Saw-flies. It is not at all improbable, however, that these moth larvæ do in reality secrete from the mouth some peculiar fluid which tends to produce the gall; for we know that very many other moth larvæ burrow in the stems of different plants without producing any abnormal swelling.

ERRATA.

Page 13, line 25, for "cupable" read "culpable."
Page 16, line 13, for "lava" read "larva"
Page 23, line 6 from bottom, for "hole" read "holes."
Page 32, line 17, for "insect" read "insects."
Page 50, line 4 from bottom, for "*leucaiæ*" read "*leucaniæ.*"

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THIRD ANNUAL REPORT

ON THE

NOXIOUS,

BENEFICIAL AND OTHER

INSECTS,

OF THE

STATE OF MISSOURI,

MADE TO THE STATE BOARD OF AGRICULTURE, PURSUANT TO AN APPROPRIATION FOR THIS PURPOSE FROM THE LEGISLATURE OF THE STATE.

BY CHARLES V. RILEY,
State Entomologist.

JEFFERSON CITY, MO.:
HORACE WILCOX, PUBLIC PRINTER.

1871.

Entered according to act of Congress, in the year 1871, by CHARLES V. RILEY, in the office of the Librarian of Congress, at Washington.

PREFACE.

To the Members of the Missouri State Board of Agriculture:

Gentlemen: I herewith submit for publication, my Third Annual Report on the Noxious, Beneficial and other Insects of the State of Missouri.

No particular action seems to have followed the suggestions thrown out in my last year's preface, as to the procuring of a better quality of paper and ink for these Reports. The impressions of the cuts which illustrate the text, are consequently quite inferior in my second Report, and fail to do justice to the engravings.

As will be seen from the following pages, many important discoveries in Economic Entomology have been made during the year, and some few insects have been very abundant. On the whole, however, we have enjoyed more than the usual immunity from insect depredations throughout the State. Complaints have been numerous, and articles giving extravagant accounts of the increase of noxious insects are continually appearing in our agricultural papers. But while some insects are on the increase, others are on the decrease, and the cause for alarm is in a great measure imaginary. More is now said and written about insects in the industrial journals of the State than formerly, because, through the agency of these Reports, the people have had their eyes opened to the importance of the subject; and the impression that insects generally are on the increase must be, in a great measure, attributed to this fact rather than to any real increase that has occurred.

The *American Entomologist*, in the columns of which some of the observations contained in this Report have already appeared, was continued during the year, and a botanical department, edited by Dr. George Vasey, of Normal, Illinois, was added to it. The charge of such a journal, together with my State duties, kept me too much confined, and for these and other reasons given, the magazine has been suspended during the coming year, 1871.

This suspension will enable me to spend more time in the field, and as these annual Reports have but a limited circulation, and as very many cultivators of the soil must in consequence, fail to get the

information contained in them, I have concluded to devote more time the coming year to lecturing; and have already prepared for that purpose a number of large, colored illustrations.

I am satisfied that by this means I can materially add to the good effected by these Reports, and I shall endeavor to fill any engagements which the officers of our county agricultural and horticultural societies may desire to make, providing they give me notification a sufficient time beforehand.

In the following pages the same rules are complied with as were laid down in my first Report. When the insects treated of are new, or the existing descriptions of them are imperfect, or in a foreign language, I have added a full description, which is, however, always printed in smaller type, so that it can be skipped by the non-interested reader. The popular name of each insect is accompanied by the scientific name, and the latter is always printed in *italics* and mostly in parenthesis, so that it may be skipped by the practical man without interfering with the text. The Order and Family to which each insect belongs, is also given under each heading. The dimensions are expressed in inches and the fractional parts of an inch, and the sign ♂ wherever used, is an abbreviation for the word "male," the sign ♀ for "female," and the the sign ☿ for neuter. It must also be recollected that many of the figures are magnified, and that the hair line at the side of such gives the natural size.

The scientific reader will notice that some of the insects are referred to the old instead of the more modern genera, and this course has been pursued because the generic nomenclature is constantly changing, and because the old name has often become thoroughly associated with the insect in the mind of the practical man, who would be confused by, and is not interested in, the nice changes taking place in classification.

All the illustrations in this, as in the previous Reports, have been drawn from life by myself, or under my direct care, unless otherwise stated.

I have secured a pleasant office, connected with that of your Secretary, at Room 29, Insurance Building, Southeast corner of Fifth and Olive streets, St. Louis, and all letters sent to me should be thus addressed.

My acknowledgments are due to the Superintendents of the following railroads, for free passes over their respective routes: The Pacific Railroad of Missouri, Atlantic and Pacific, St. Louis and Iron Mountain, Hannibal and St. Joseph, North Missouri, Chicago and St. Louis, Illinois Central, and the Rockford, Rock Island and St. Louis.

All which is respectfully submitted by

CHARLES V. RILEY,
State Entomologist.

St. Louis, Mo., December 2, 1870.

NOXIOUS INSECTS.

SNOUT-BEETLES.

(Coleoptera Curculionidæ).

AN ACCOUNT OF SOME OF THOSE SPECIES WHICH ARE INJURIOUS TO FRUITS AND VEGETABLES.

In my First Annual Report I gave an account of the common Plum Curculio, which was as complete as our knowledge of the insect would then permit. Since the publication of that Report many new and most important facts, relating to this insect, have been brought to light, and I deem it wise in this review of some of our more injurious snout-beetles, to lay these facts before the reader. Many of them were embodied in an essay read by myself at the Fifteenth Annual Meeting of the Illinois State Horticultural Society, recently held at Galesburg, in that State, and therefore, with some important additions, I reproduce that essay, which embraces the first five insects here treated of.

Insects, like other animals, derive their nourishment from the vegetable and animal kingdoms; but a glance is sufficient to show that they possess a far greater field of operations than all the other animals combined. Indeed, the food of insects is a theme so large that I might occupy page after page by dwelling upon it alone. The other animals use as food but a very small portion of the inexhaustible treasures of the vegetable kingdom, and the remainder is unpalatable or even poisonous to them. Not so with insects, for, from the gigantic *Banyan* which covers acres with its shade, or the majestic Oak, to the invisible fungus, the vegetable creation is one vast banquet, to which they sit down as guests. The larger plant-feeding animals are also generally confined, in their diet, to the leaves, seeds or stalks, being either foliaceous or farinaceous; but insects make every possible part of a plant yield them valuable provender. We have an excellent illustration of this omnipresent character of insects in those species which are well known to attack the common apple tree. Thus, beginning at the root, we find it rendered knotty and unhealthy on the outside by the common Root-louse (*Eriosoma pyri,* Fitch), while the heart is often entirely destroyed by one or the other of two

gigantic Root-borers (*Prionus imbricornis*, Linn, and *P. laticollis*, Drury). The trunk is riddled by the larvæ of several Long-horn beetles, and pre-eminently by the Two-striped Saperda (*Saperda bivittata*, Say), as well as by other smaller beetles; the liber and alburnum are destroyed by the Flat-headed borer (*Chrysobothris femorata*, Fabr.), the outer bark eaten by bark beetles (*Scolytus* family) and sucked by Bark-lice peculiar to it. The branches and twigs are bored along the axis and pruned by the larvæ of the common Pruner (*Elaphidion villosum*, Fabr.), and by that of the Parallel Pruner (*E. parallelum*, Lec.), girdled by the Twig-girdler (*Oncideres cingulatus*, Say*), sawed and rasped by the Periodical Cicadas (*Cicada septemdecim*, Linn, and *C. tredecim*, Riley), otherwise known as Seventeen-year Locusts, by tree-hoppers and a dozen other Homopterous insects; bored into from the side by the Twig-borer (*Bostrichus bicaudatus*, Say), wounded by the bites of such beetles as the New York Weevil (*Ithycerus novæboracensis*, Forster), or pierced as by a red-hot wire by small boring beetles (*Scolytidæ*).

The buds before they expand are infested with the larvæ of the Apple Bud-moth (*Grapholitha oculana*, Harr.), or entirely devoured by voracious cut-worms (*Agrotis scandens*, Riley, etc.). The blossom has no sooner unfolded its delicate and beautiful petals than it is devoured entirely either by the Brazen Blister Beetle (*Lytta ænea*, Say), the Striped Cucumber Beetle (*Diabrotica vittata*, Fabr.), the Rose bug, or by a great many other insects that might be mentioned, some, as the different bees, confining themselves to the pollen or honey from the nectaries, while others again prefer other parts. The young fruit is either eaten partly or entirely by Snapping beetles (*Melanotus communis* and *M. incertus*), or punctured by either the Plum or Apple Curculios, and afterwards bored through and through by their larvæ, or by that ubiquitous Apple Worm (*Carpocapsa pomonella*); as it matures it is eaten into by the larvæ of the Plum Moth † (*Semasia prunivora*, Walsh), rendered putrid by the Apple Maggot (*Trypeta pomonella*, Walsh), and by the Apple Midge (*Molobrus mali*, Fitch); as it ripens it is gouged by the Flower Beetles (*Euryomia inda* and *E. melancholica*), and disfigured by a variety of other insects, while the skin is often gnawed off and corroded by the larvæ of the Rose Leaf-roller (*Loxotænia rosaceana*, Harr.); and even the seed, if it should be preserved, will be attacked by the Grain Sylvanus (*Silvanus surinamensis*, Linn.), the Dwarf Trogosita (*T. nana*, Melsh.) and the larvæ of one or two small moths. And as to the leaves, they are not only sapped and curled by the Apple Plant-louse (*Aphis mali*, Fabr.), and by leaf hoppers; rolled by several leaf-rollers; folded at the edges by a small pale, undescribed worm which I shall soon describe; blistered by the Rosa Hispa (*Uroplata rosa*, Weber);

*I have bred specimens of this insect from apple twigs.

†Inappropriately so called by Mr. Walsh, as I shall presently show.

crumpled by the Leaf Crumpler (*Phycita nebulo*, Walsh), mined by the Apple Micropteryx (*Micropteryx pomivorella*, Pack.); skeletonized and tied together by another undescribed worm, which I shall some day name *Acrobasis Hammondii;* but they are greedily devoured by a whole horde of caterpillars, from the tiny *Micropteryx* to the immense Cecropia worm, some of which confine themselves to the parenchyma, some to the epidermis, some to the tender parts, without touching the veins, while others bodily devour the whole leaf. The sap forms the sole food of some insects, and even when the poor apple tree dies, a host of different insects revel in its dead and decaying parts, and hasten its dissolution, so that it may the more quickly be resolved into the mold from which it had, while living, derived most of its support, and through which it is to give nourishment for the young trees which are to take its place.

Thus we perceive that there is not a single part of the apple tree which is not made to cradle, or to give nourishment to some particular insect, and the same might be said of almost every plant that grows on the face of the earth, even those which produce resinous or gummy substances, or which are pithy in the center, having special insects which feed upon these parts and on nothing else. There are insects— the gall makers, for instance—which, not satisfied with any existing part of the plants, as such, cause abnormal growths, in which their young are reared.

Nor are insects confined to vegetables in their recent state. The block of hickory wood, fifty years after it is made up into wagon wheels, is as palatable to the Banded Borer (*Cerasphorus cinctus*, Drury), which causes "powder-post," as it was to the Painted Borer (*Clytus pictus*, Drury) while green and growing; and a beam of oak, when it has supported the roof of a building for centuries, is as much to the taste of an *Anobium* as the same tree was while growing, to the American Timber Beetle (*Hylecœtus Americanus*, Harr.) Some, to use the words of Spence, "would sooner feast on the herbarium of Brunfelsius, than on the greenest herbs that grow," and others, "to whom

'——— a river and a sea
Are a dish of tea,
And a kingdom bread and butter,'

would prefer the geographical treasures of Saxton or Speed, in spite of their ink and alum, to the freshest rind of the flax plant."

Indeed, it would be difficult to mention a substance, whether animal or vegetable, on which insects do not subsist. They revel and grow fat on such innutritious substances as cork, hair, wool and feathers; and "with powers of stomach which the dyspeptic sufferer may envy, will live luxuriously on horn;" they insinuate themselves into the dead carcasses of their own class; they are at home in the hottest and strongest spices, in the foulest filth, in the most putrid carrion; they can live and thrive upon, or within the living bodies of the larger animals, or of those of their own class; they are at home in

the intestial heat of many large animals, reveling in the horse's stomach, in a bath of chyme of 102° Fahr., or in the bowels of man, in an equally high temperature. Some have even been supposed to feed on minerals, and, not to dwell upon Barchewitz's tale of East India ants, which eat iron, certain it is that the larvæ of our May flies (Ephemeræ) do eat earth, and I have known the larvæ of the common May Beetle to feed for three months upon nothing but pure soil; but in both these cases the insects undoubtedly derive nourishment from the vegetable matter which is extracted from the earth by the action of the stomach.

These facts will serve to show that, seek where we may, we cannot find a place or a substance in which or on which, some insect does not feed. They people the atmosphere around us, swim at ease in the water, and penetrate the solid earth beneath our feet; while some of them inhabit indifferently all three of these elements at different epochs of their lives.

Now when we reflect that there are at least half a million—if not a full million—distinct species of insects in this sublunary world of ours, and that their habits and habitations are so diversified, it would really seem as though entomology was a subject too vast for any one man to shoulder; and indeed it is in all conscience extensive enough. The science of entomology is, however, so perfect in itself, and its classification so beautiful and simple that a particular species is referred to its Order, its Family, its Genus, and finally separated from the other species of that genus, with the greatest ease, and with a feeling of true satisfaction and triumph, by those who have mastered the rudiments of the science. And, very fortunately, it is not necessary for the practical fruit-grower to enter into the minutiæ of species or even of genera in order to learn the habits of the insects which interest him in one way or another. These minutiæ must be left to the professed entomologist.

There is not an insect on the face of the globe which cannot be placed in one or the other of seven, or more properly speaking, eight great Orders; so that, unlike the botanist, the entomologist is not bewildered by an innumerable array of these Orders, though he has five times as many species to deal with. These Orders comprise about two hundred families, many of which may, for practical purposes, be grouped into one family—as, for instance, the seven families of Digger-wasps and the five large families which have all the same habits as the true or genuine Ichneumon-flies. Many more may be neglected as small, rare, or unimportant; so that practically there will remain about a hundred family types to be learned. Each family, as Agassiz, has well remarked, may, with a little practice, be distinguished at a glance by its general appearance, just as every child with a little practice, learns to distinguish the family of A's from the family of B's, and these from the family of C's in the alphabet. There is the old English A, the German text A, and a host of orna-

mental A's, both in the capital letter and the small or "lower-case" letter, as the printers call it; but the family likeness runs through all, and it is astonishing how quick a child learns to distinguish each family type. It is true there are a few abnormal or eccentric insects —there were some which deceived even Linnæus—which put on the habit of strange families, just as an eel, which is a true fish with fins, puts on the habit of a snake—a reptile without fins. But these are the exceptions and not the rule.

Now it is wisely ordained that every family, as a general rule, has not only a distinctive family appearance, but also distinct family manners. For example, nobody ever saw an Ichneumon-fly construct a nest and provision it with insects, as does a Digger-wasp; and nobody ever saw a Digger-wasp deposit its eggs in the body of a living insect at large in the woods as an Ichneumon-fly does. But each family maintains its peculiar family habits, and cannot be induced to deviate from them.

So universally is this the case, that if an insect is brought me which I never saw in my life, I will tell half its history at a glance. It is this "Unity of Habits," this beautiful provision of nature—definite family likeness, accompanied by definite family habits—which so simplifies the task of the practical man; for, instead of having to study the diversified habits of half a million species, he has but to acquaint himself with the appearance and characteristics of one hundred families; and if the rudiments of Entomology had been taught in the schools of this country, so that the farmer had become familiar with these hundred family types, he would now be much better able to cope with his insect enemies. When I think that it would take a child no longer to learn these one hundred family types than it does to learn the one hundred different types which compose the four alphabets—the Roman capital and small alphabet and the writing capital and small alphabet—I fully expect, and sincerely hope, that in the public schools of this country we shall soon have text-books introduced which will cover the ground as well, and occupy the same place as do those useful works of Leunis, and Troschel and Ruthe, in the public schools of Germany.

With these few remarks, which are intended to show that the practical man may easily obtain a general knowledge of his insect friends and enemies, notwithstanding the wide field of their operations and the immense number of species which exist, we will now dwell for a while on one of these families, which deeply interest us as fruit-growers, namely:

THE CURCULIONIDÆ OR SNOUT-BEETLES.

This is one of the very largest and most conspicuous families in the Order of Beetles (*Coleoptera*), comprising, as it does, over 10,000 distinct and described species. It is at once distinguished from all the

other families of beetles by the front of the head being produced into a more or less elongated snout or rostrum, at the extremity of which the mouth is situated. This snout is sometimes very long and as fine as a hair (genus *Balaninus*), and sometimes as broad as the head (genus *Brenthus*); but it always forms part and parcel of the head, and does not articulate on it as does the snout or proboscis of the true Bugs (*Hemiptera*), or the tongue of Moths and Butterflies. The other chief characteristics of the family are an apparently four jointed tarsus or foot (though in reality there are more generally five joints), an ovoid form narrowing in front, the sides pressed by the convex elytra or wing-covers, the antennæ or feelers attached to the snout, and either elbowed or straight, and composed of nine, ten, eleven or twelve joints—the first of which is always long, and the terminal three generally united in a club or knob; and finally stout legs with swollen thighs, sometimes bearing spines.

The larvæ of these snout-beetles are whitish or yellowish and fleshy grubs, usually without legs or having only in the place of them fleshy tubercles, which in a measure perform the functions of legs;* the body is oblong, with the back generally arched but sometimes straight. With these characteristics in mind, the farmer cannot fail to recognize a snout-beetle when he sees one. Now there is hardly one of the one hundred families that I have referred to from which so many injurious species can be enumerated, for with the exception of an European species (*Anthribus varius*) whose larva was found by Ratzeburg to destroy bark-lice, they are all vegetarians, the larvæ inhabiting either the roots, stems, leaves or fruits of plants; and the beetles feeding on the same. So whenever you find an insect with the characters just given, you may rest morally certain that it is injurious, and should be destroyed without mercy. This family is not only one of the most injurious, but, on account of the secretive habits of the larvæ, the insects comprising it are the most difficult to control. When a worm is openly and above board denuding our trees, we at least readily become aware of the fact, and can, if we choose, apply the remedy; but when it surreptitiously, and always under cover, gnaws away at the heart of our grains and fruits, we become in a measure helpless to defend ourselves. But even here where the enemy is so well ambushed and hidden, the proper tactics, based on thorough knowledge, will frequently enable us to penetrate the defenses and conquer the foe.

Before leaving this subject of families, let me impress upon the mind another important fact, namely, that the family is not peculiar to any one country, and that while species vary, the family has the same habits and characteristics all over the world. Thus in Europe

*It is generally unqualifiedly stated by authors that Curculionid larvæ are apodous; but there are exceptions to the rule, and I may cite as an example the larva of *Cratoparis lunatus*, Fabr., which I have found in fungi, and have bred to the perfect state, and which has six conspicuous thoracic legs.

we find the snout-beetles as injurious, and as difficult to manage—if not more so—than they are in this country. One species (*Rhynchites conicus*, Herbst.,) deposits eggs in the twigs of Pear, Plum, Cherry and Apricot, and girdles the twig to make it fall; another, (*Rhynchites bacchus*, Schœn.) infests the fruit, and still another (*Anthonomus pyri*, Schœn.) the flower bud of the Pear. One, (*Rhynchites betuleti*, F.,) rolls up grape leaves and partly cuts the stems, so that they perish, while another, (*Anthonomus pomorum*, Schœn.,) infests the blossom bud of the Apple, and renders it unfertile. Still another inhabits the blossom bud of the Cherry. *Balaninus nucum* is found in their common Hazel-nut, and *B. cerasorum* in Cherry pits; *Apion apricans* devours the seed of Clover; *Otiorhynchus sulcatus*, Schœn., infests the crown of strawberries and two different species (*Baris chlorizans*, Schœn., and *Ceutorhynchus napi*, Schœn.,) infest the stems of cabbages and turnips.

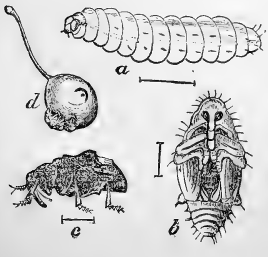
But after all, a single species—the "little Turk," for instance—sometimes causes more loss of fruit in this country than all the above enumerated species do to the European cultivator, and though much of this comparative incapacity for harm, on the part of their insects, may be in a measure due to the better knowledge of his foes which the transatlantic cultivator possesses; to the more careful culture which he pursues, and the usually limited extent of his orchard, compared with ours; yet it greatly depends on other causes, which it is not necessary now to dwell upon. So I will at once proceed to say a few words about those of our own Snout-beetles, which more particularly interest us.

THE COMMON PLUM CURCULIO—*Conotrachelus nenuphar*, Herbst.

IT IS SINGLE BROODED, AND HIBERNATES AS A BEETLE.

I shall not here repeat what has already been published about this insect; but shall confine my remarks principally to the unsettled and mooted points in its natural history, and to the new discoveries that have been made since the appearance of my first Report. I am glad to be able to say that I have forever settled the principal question, namely, as to its being single or double brooded. Authors have, from the beginning, held different views on this subject, and this fact should not surprise us, when we bear in mind that

[Fig. 1.]



they reasoned simply from conjecture; nor will it surprise us when we understand the facts in the case. The facts that fresh and soft Curculios are found in this latitude as early as the last of June, and that they still come out of the ground in August, or as late as September, and even October in more northerly latitudes, are well calculated to mislead; while it was difficult to imagine an insect living ten months before ovipositing, without dwindling away through the action of its enemies. But in the beetle state, the Curculio has few, if any enemies, and in my former writings on this subject, I have shown that the other facts do not in the least prove the insect to be double-brooded. Among those whose opinions commanded respect, from their profound entomological knowledge and general accuracy, was Mr. Walsh, who, during his last years, strenuously contended that this insect was double-brooded. For several years I have entertained a different opinion, believing that it was single brooded, as a rule, and only exceptionally double-brooded; and the facts so fully bear me out in this opinion, that were my late associate living to-day, I should bring forth the testimony with a feeling of triumph, for he was not often in the wrong! It is worthy of remark, however, that Mr. Walsh's first impression, as given by him in the year 1867*, was that this insect is single brooded; his first opinion thus coinciding with what I have now proved to be the facts in the case. In my first Report I have reviewed the experiments which led him to change his opinion, and have shown that they did not warrant his final conclusion.

The many words that have been penned in the discussion of this question would fill a volume; but one stern fact, one thorough experiment, is worth more than all the theories that were ever conceived, or the phrases that were ever written on the subject. At first it seems to be a very simple question to settle, but the fact that it remained unsettled so long would indicate the reverse. Judge A. M. Brown of Villa Ridge, at my suggestion, endeavored in the summer of 1869 to solve the problem by imprisoning the first bred beetles and furnishing them with plucked fruit. Dr. Hull partially performed a like experiment, and I did the same myself; but we were met by the advocates of the two-brooded theory with the objection that such a test was of no value, as the Curculio would not deposit on plucked fruit or in confinement; and to add weight to their argument they could cite us to numerous instances among butterflies to prove that many insects really will not deposit in confinement. But, as we shall see, they placed too much confidence in the instinct of Mrs. Turk when, from such premises, they made these deductions apply to her.

As I proved over and over again, the question could not be solved with any more certainty, by confining beetles to living boughs containing fruit, as the boughs could not well be covered with any sub-

* Practical Entomologist, Vol. II., No. 7.

stance through which the beetles would not gnaw their way out. So I determined last spring to build a frame over a large tree and entirely enclose it in stout gauze, that would neither let a flea in or out, much less a Curculio. Having accomplished this before the blossoms had fallen off the tree, I awaited with pleasurable interest the result from day to day, from week to week, and from month to month; engaging a competent person to watch, when, from necessity, I was obliged to be away. It were worse than waste of time to detail here the many interesting observations made on this tree which I had under control, or to enumerate the many other experiments which I conducted in other ways, or the innumerable facts obtained; and it will suffice to give in a summary manner the results—premising only that every precaution was taken, and no expense spared, to prevent failure; that the experiments were satisfactory beyond my expectations, the results conclusive beyond all peradventure, and that I can prove every statement I make. To sum up then:—*The Plum Curculio is single-brooded*, and I have a number now alive *which were bred during the latter part of June from the first stung peaches.* (At the time the printer is ready for this Report the beetles are still alive and flourishing—February 24th, 1871.) But, as there seem to be exceptions to all rules, so there are to this; yet the exceptions are only just about sufficient to prove the rule, for as far south as St. Louis not more than one per cent. of the beetles lay any eggs at all, until they have lived through one winter; or in other words, where one female will pair and deposit a few eggs the same summer she was bred, ninety-nine will live on for nearly ten months and not deposit till the following spring. In more northern latitudes I doubt if any exceptions to the rule will be found.

As to the other mooted point, namely, whether this insect ever hibernates under ground in the larva state, I am perfectly satisfied that it never does, but that it passes the winter invariably as a beetle, under all sorts of shelter in the woods; generally, however, near the surface of the ground. Indeed, it often makes for itself a hole in the ground, seldom however deep enough to more than barely cover its own body. In short, there is very little to alter or modify in the established facts in its natural history, which I have already published. The egg, instead of being "oval," as there stated, would be better described as "oblong-oval," measuring exactly 0.03 inch in length, and being nearly three times as long as wide. It should also be remarked here, that when depositing the eggs in apples, the female often neglects the usual symbol of Mohammedanism, which she so invariably inscribes upon stone fruit; and that where this mark is made on apples, it more easily becomes obliterated.

During their beetle life, these insects feed continually, just as long as the weather is mild enough to make them active. While fruit lasts, they gouge holes in it, and after peaches have gone, apples are

badly attacked. They also gnaw large holes in the leaves, and when nothing else presents, will feed on the bark of the tender twigs.

The beetles often make a peculiar creaking noise (a fact not mentioned before of this species) by rubbing the tip of the abdomen up and down against the wing-covers.*

Let us be thankful, therefore, that there can no longer reasonably be difference of opinion, or discussion on these questions, which, though of no very great practical importance, were yet of great interest to us all.

IT IS NOCTUNRAL RATHER THAN DIURNAL.

Before leaving this little Turk, however, I have some other facts to mention which were first brought to light the present year, and which have a most important practical bearing. The people of the West have been repeatedly told, and with so much assurance that they no doubt have all come to believe it as gospel, that Curculios fly only during the heat of the day, and that it is useless to endeavor to catch them after say 10 o'clock in the morning. What I am about to utter will no doubt astonish many, but I know whereof I speak. *The Curculio is a nocturnal rather than a diurnal insect; is far more active at night than at day, and flies readily at night into the bargain.* If any one doubts this assertion, let him go into his peach or plum orchard at midnight with a lantern and sheet, and he will catch more than he could during the day, and will also find, to his sorrow, that they are then much more nimble and much bolder—

*A great many different beetles belonging to widely different families have the power of making a stridulating creaking noise, and though the instrument is found upon different parts of the body in different species, yet it is always made after one plan, namely, a file-like rasp and a scraper. In Darwin's new book (Descent of Man, pp. 366–73) an interesting account of the different methods employed will be found. Every entomologist knows how commonly this creaking noise occurs in the Long-horn beetles, and that the rasp is situated on the mesothorax and is rubbed against the prothorax. In the Burying beetles (NECROPHORIDÆ) these rasps are situated on the fifth abdominal joint, and are scraped by the posterior margin of the elytra. In the Dung-beetles again it is variously situated upon different portions of the body. Dr. Fitch (10th Ann. Rep. p. 12) has noticed the creaking noise made by the Three-lined Leaf-beetle (*Lema trilineata*) which is produced by the same motions as those witnessed in our Curculio; but in this instance, as in all other stridulating Chrysomelidæ, the rasp is situated on the dorsal apex of the abdomen known as the pygidium, and is scraped by the wing-covers; while in the closely allied Curculionidæ which have this power the parts are completely reversed in position. Any one who will take the trouble to carefully examine the wing-covers of our Plum Curculio will find on the lower apical edge of each, a horny, slightly raised plate, about a third as long as the whole wing-cover, and transversely and obliquely ribbed by numerous parallel ridges. There is also a longer cord or carina near the sutural edge which may help to intensify the noise. The dorsal apex of the abdomen or pygidium forms a yellowish and roughened plate, with the sides horny and emarginate, so that when the abdomen plays up and down, these horny edges grate or scrape at right angles against the rasp.

In some instances the stridulation is possessed principally by one sex and serves no doubt as a sexual call; but with our Curculio as with most other stridulating beetles, both sexes seem to share alike in the power, and it then no doubt serves as a mutual call, or is used under the influence of distress, fear, or even pleasure; for I have always more particularly noticed the noise of an evening when the Curculios were most active and preparing for their active night work.

scarcely feigning death at all. Indeed, with the exception of such females as are busily occupied in depositing eggs, most of the Curculios rest during the day, sheltered either by the foliage or branches of the tree, or by any extraneous substance on the ground near by. They are also more active in the evening than in the morning, and these facts lead us to the important question, whether the morning or the evening is the best time to jar the trees. My experiments so far are not conclusive, for I have some days caught more in the morning, and at others more in the evening. All other things being equal, the evening will prove preferable to the morning, from there being less dew at that time; and I particularly draw attention to this matter now, that the proper experiments may be instituted during the coming year by more than one individual.

THE RANSOM CHIP-TRAP PROCESS.

Another grand and successful mode of fighting the little Turk was also brought to light again, and to a great extent practiced the past summer. I allude to the Ransom chip process for entrapping this insect. About the middle of May the Horticultural world was startled by a somewhat sensational article, which was the burden of an extra to the St. Joseph (Michigan) *Herald*, headed:—"Great Discovery—Curculio Extermination Possible." The process consists in laying close around the butt of the tree pieces of chips or bark, under which, according to their instinct, a great many of the Curculios secrete themselves during the day, and may thus be easily destroyed. Now that we better understand this insect's habits, we also better comprehend the philosophy of this process. Being noctural in their habits, the beetles naturally seek shelter during the day, and especially is this the case early in the season, when the days are chilly, and before the females are too much engaged in egg depositing. Numerous opinions were expressed as to the value and efficiency of this method; but I will here repeat my own, as given to the readers of the *American Entomologist and Botanist;* first, because I endeavored to be candid and truthful, and secondly, because the opinions expressed have been so far fully corroborated by subsequent experience. Let it be distinctly understood that in recording what I believe to be the facts in the case, I have no wish to detract one particle from the credit due Mr. Ransom, for bringing this method prominently before the people, and demonstrating its practical applicability; for to him undoubtedly belongs the honor of the re-discovery and of the proper application of the method:

"We are really sorry to damp the ardor and enthusiasm of any person or persons, when enlisted in such a good cause, but truth obliges us to do so, nevertheless. Of course Curculio extermination is possible! but not by the above method alone, as our Michigan friends will find to their sorrow. For a short time, early in the season, when the days are sometimes warm and the nights cold, and before the

peach blossoms have withered away, we have succeeded in capturing Curculios under chips of wood and in other such sheltered situations; but we have never been able to do so after the fruit was as large as a hazlenut, and the little Turk had got fairly to work. Our Michigan friends will, we fear, find this to be too truly the case.

"This process, furthermore, cannot well be called a new discovery, because it was discovered several years ago, as the following item from Moore's *Rural New Yorker* of January 28th, 1865, will show:

"HOW TO CATCH CURCULIO.—In May last we had occasion to use some lumber. It was laid down in the vicinity of the plum yard, and on taking up a piece of it one cold morning, we discovered a number of curculios huddled together on the under side. On examining other boards we found more, so we spread it out to see if we could catch more, and we continued to find more or less every day, for two weeks. We caught in all one hundred and sixty-one. So I think if people would take a little pains they might destroy a great many such pests. These were caught before the plum trees were in flower. What is most singular is, that we never found a curculio on a piece of old lumber, although we put several pieces down to try them. They seemed to come out of the ground, as we could find them several times a day by turning over the boards.

Johnsonville, New York. MRS. H. WIER.

"But though Mr. RANSOM cannot properly claim to have made a new discovery, and although this mode of fighting will not prove sufficient to *exterminate* the Curculio, yet we greatly admire the earnestness and perseverance which he has exhibited. In demonstrating that so great a number of the little pests can be entrapped in the manner described, Mr. R. has laid the fruit growers of the country under lasting obligations to him. It is a grand movement towards the defeat of the foe, and one which, from its simplicity, should be universally adopted early in the season. But we must not relinquish the other methods of jarring during the summer, and of destroying the fallen fruit; for we repeat that the Plum Curculio will breed in the forest."

I subsequently visited St. Joseph, for the express purpose of examining more closely into Mr. Ransom's Curculio remedy. I found that so few Curculios had been caught under the chips after the first week in June, that nearly everybody, except Mr. Ransom, had for some time abandoned the method, and were jarring their trees by one process or another. Mr. Ransom himself, by dint of unusual perseverance and great care in setting his traps, had much better success than I had expected he would. On the 15th June he caught 78; on the 16th, 97; and on the 17th, 71. For about a week after this he scarcely caught any, but from the 24th to the 27th inclusive, he caught about 300. On the 6th of July I accompanied him around the outside rows of his orchard and caught five under the traps. We had no opportunity to use the sheet, but I am satisfied that more could have been jarred down. Mr. R. had a very fair crop of peaches, and—forgetting that crops have often been grown before with very little care, and that others around him who did not bug so persistently had fruit also this year—is very sanguine of his new method, and too much inclined, perhaps, to attribute his crop solely to this remedy. Nevertheless, contrary to the impression made by his published views, he was candid enough to admit that it might be found necessary to resort to the jarring process, after a certain season of the year; and indeed the number of stung peaches on the ground showed too plainly that there is no hope of *extermination* by the chip plan alone. The soil around St. Joseph is, for the most part, a light sandy loam, never

packing, and very easily kept in good cultivation. To this character of the soil must be attributed much of the success with the Ransom method; for I am satisfied, after full experiment, that in the warmer climate and heavier soil of St. Louis, it is of no practical use after the middle of May, or at the farthest, after the first of June. The few specimens that I have captured by this method at St. Louis were found under small pieces of new shingle; and Mr. W. T. Durry, who has 2,300 trees in his orchard at St. Joseph, also found this the best kind of trap. Mr. Ransom, however, prefers small pieces of oak bark, which he places close around the tree, with the inner or concave side pressed to the ground. Stones do not answer well, and corn cobs are objectionable because it requires so much time to discover and destroy the Curculios, which hide in their deep cavities.

The best time of day to take the Curculios from under the chips is undoubtedly in the afternoon; but it must not be left too long, as they begin to leave and scatter over the trees as soon as the sun approaches the horizon. The chips should be laid around the trees as soon as the frost is out of the ground, or at least by the time the blossoms begin to expand; for more beetles will be caught under them during a few weeks thus early in the season than throughout the rest of the year.

Before concluding this branch of the subject, I earnestly urge upon fruit-growers throughout the State to give this process a good trial during the coming season, and to report the results to me. The observations of a hundred persons in as many different parts of the State must necessarily be of more value than those of a single individual in any one locality; and as the process was not prominently brought before the public last year, until it was too late to make thorough experiments, it is very desirable to have the true value of the method in Missouri definitely ascertained in 1871. To arrive at such definite knowledge of its value, I need the co-operation of intelligent fruit-growers, and for this reason I hope that notes and experiments will be made and sent to me at my office, any time during the summer. The number of trees experimented on, number of beetles captured, time of year, hour of day, character of soil, and all other facts connected with the experiments should be noted; as they all help us to a more thorough knowledge of the true value of the process

KEEPING IT IN CHECK BY THE OFFER OF PREMIUMS.

After visiting St. Joseph and vicinity, I passed into Ontario, where I found the trees overloaded with fine unblemished fruit. I found my friend, Mr. Wm. Saunders, of London, also much occupied with, and interested in, the Curculio question. He was, in fact, carefully counting different lots of this insect which had been received from different parts of the Dominion; for be it known, that the enterprising Fruit-Growers' Association of Ontario, in its praiseworthy efforts to check the increase of the Curculio, offered *a cent per head* for every one

which should be sent to our friend, who happens to be secretary of that body. What would our own people think if the Legislature or the State Horticultural Society should offer an equally liberal premium *per capita* for every little Turk captured? Wouldn't they set about capturing them in earnest, though! The Legislature might stand it, and I am not sure but that some such inducement, held out by the State to its fruit-growing citizens, would pay, and prove the most effective way of subduing the enemy. But the Horticultural Society that should undertake it, would have to be pretty liberally endowed. Just think of it; ye who catch from three to five thousand per day. The bugs would pay a good deal better than the peaches. However, very fortunately for the Ontario Fruit-Growers' Association, their good offer did not get noised abroad as much as it might have been, and the little Turk occurs there in such comparatively small numbers, that up to the time I left only 10,731 had been received.

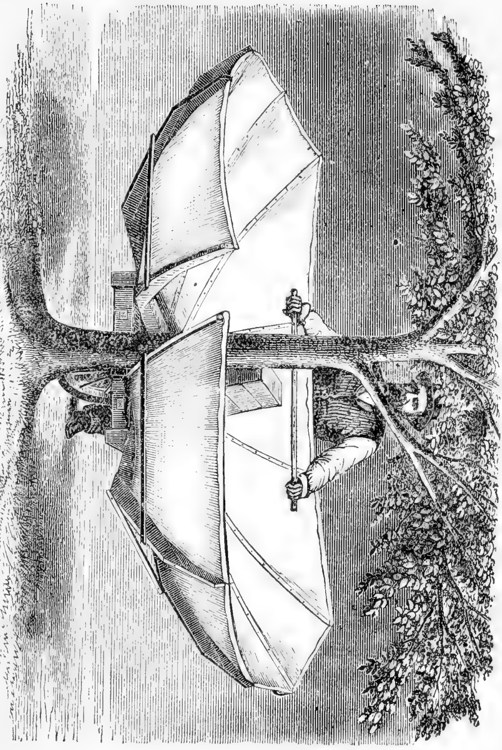
PARIS GREEN AS A REMEDY.

Mr. G. M. Smith, of Berlin, Wisconsin, in an article written last fall to the St. Joseph (Mich.) Horticultural Society, recommends Paris Green for the Plum Curculio. Even if the uniform application of such a poisonous drug on large trees were practicable, it would never succeed in killing one Curculio in a hundred. Paris Green kills the leaf-eating beetles by being taken internally with the leaves; but the Curculio, with its snout, prefers to gouge under the skin of the fruit, and only exceptionally devours the leaves. Yet, notwithstanding the palpable absurdity of the remedy, it has very generally passed from one journal to another without comment.

JARRING BY MACHINERY.

Of course there is no more expeditious way of jarring down the Curculio than by the Hull Curculio-catcher (Fig. 2.) Yet I confess that after extensive observations in many different parts of the country I am forced to the conclusion that this machine does not give the satisfaction one could wish. I have already shown that where it was constantly used the trees suffered serious injury from bruising, and it is a rather significant fact that in most orchards where it has been introduced, some modification has soon followed, or else it has been entirely abandoned; while in the East they still adhere to the improved stretchers and mallet. It seems to me that the machine, as made by Dr. Hull, two years ago, was not only too heavy and unwieldy, but incapable of giving the requisite sharp jarring rap to the branches of a large tree without causing too much injury to the trunk; and that if a modification of it could be made to satisfy the peach-grower, there would soon be a greater demand for such a machine.

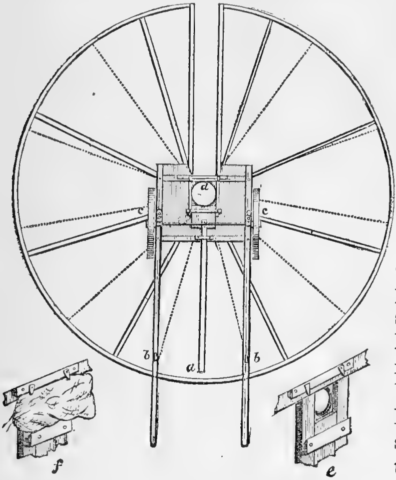
[Fig. 2.]



[A full description of this machine, without any figure, was given in my first Report, pp. 60-61.]

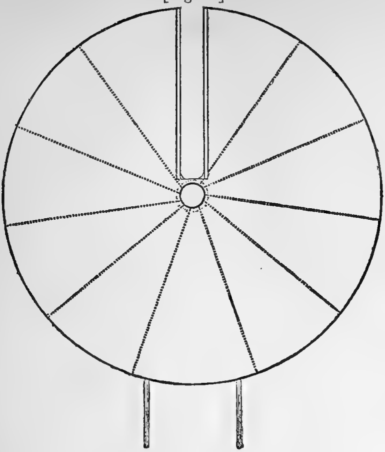
As a step in the right direction I will briefly describe a machine which I have herewith illustrated, (Fig. 3, back view; Fig. 4, front view), and which I found in quite general use around St. Joseph and Benton Harbor, Michigan. It was gotten up by Mr. L. M. Ward of the latter place, and proves, in the orchard, to have decided advantages over the Hull machine, of which it is a modification. It is a much lighter machine, and, as the diagrams indicate, instead of running on a single wheel it is carried and balanced by two, (Fig. 3, *c c*) and supported with legs on the handles, (Fig. 3, *b b*), when not running. The Curculios and stung fruit are brushed through a hole in the centre (Fig. 3, *d*), and as the operator passes from one tree to another he closes this hole, to prevent the beetles from escaping, by means of a slide, (Fig. 3, *a*), which he has under control. Bags previously prepared, by being fastened on a square piece of wood with a hole in the centre corresponding to a hole in the side of the bag, are snugly buttoned below (Fig. 3, *e* and *f*), so as to secure everything that falls through from above, and when one bag is full it is easily replaced by another, and its contents destroyed by scalding, or otherwise, and emptied out. In most of the orchards where this machine was being used, the jarring was performed by a separate mallet, which is easily hung, as is also the brush, on the shafts when the machine is being operated by one person, or, which I think a better way, where help is not scarce, it can, with the brush, be carried by a second person (an intelligent boy will answer,) who performs the jarring and brushing while the first person wheels the machine.

[Fig. 3.]



The machine is simple in construction, and any one with ordinary mechanical ability can build it—modifying, of course, the diameter of the wheels and the inclination of the sheet to suit the character of his trees or of his ground. Mr. Ward has taken no patent out for it, and the machine is, therefore, public property. The platform may be made narrower than shown in the illustration, for the nearer the wheels approach and the lighter the machine, the better. It has been argued in favor of the one-wheel machine, that it can be more easily

[Fig. 4.]



run on rough ground and more readily turned, which, in a great measure, is true; but the Ward machine might be so made that it could easily be tilted on one wheel in turning, and our Benton Harbor friends have so far found no difficulty in operating it. The two wheels have the additional advantage that the machine is not rendered unwieldy by strong wind. It also stands firm when left by the operator, who is thereby better enabled to use a mallet if he prefers it, the mallet being hung to the shafts, and taken down after the machine is wheeled into position. Either machine can be used with a bumper, or with a mallet, and there are certain rules which should be adopted in jarring for the Curculio, no matter whether a one-wheel or a two-wheel machine is used. These rules are: First. In jarring with a mallet, it is best to prepare each tree by squarely sawing off some particular limb, or else the mallet must be well protected with rubber to prevent bruising of the tender bark. The former custom is by far the best, as we are enabled to give the tree a sharp, vibrating rap with the bare, hard wood. Secondly. If the mallet is dispensed with, and the tree is bumped with the machine—a method which certainly has the advantage of expedition—it will be found altogether more profitable to drive a shouldered spike or to insert a shouldered screw in the trunk at the right distance from the ground, and the jarring can then always be done on this spike without injury to the tree.

If the trees are headed high enough to admit of a sufficient inclination of the canvas, the beetles will naturally roll to the centre and fall into whatever receptacle there may be for them below; but such an inclination is not often practicable, and the brush or broom is almost always needed.

The orchardist must also be guided in his choice of machines by the character of his land, for the two-wheel machine doubtless owes much of its success around St. Joseph, Michigan, to the smoothness of their land. No machine will work well on rough, cloddy soil.

There are various improvements that might be made in the above machine by any ingenious person, and at my suggestion Mr. J. E. Porter of the Eagle Agricultural Works, Ottawa, Illinois, has commenced building these two-wheel machines with adjustable arms. The canvas also is to be so made that it can be fastened on and taken

off again so that the whole may be more compactly packed for shipping, and for storing away out of the wet. Exclusive of the canvas, the whole can be made ready for shipment for from $16,00 to $18,00, and the machine will no doubt be advertised the coming season.

It is gratifying to know also that the inventive genius of some of our Western men is being applied to the improvement of this implement. Thus Messrs. Claxton & Stevens of the Insane Asylum, St. Louis county, have just applied for a patent on a one-wheel machine, the principle feature of which is a bumper which works with a spring.

[Fig. 5.]

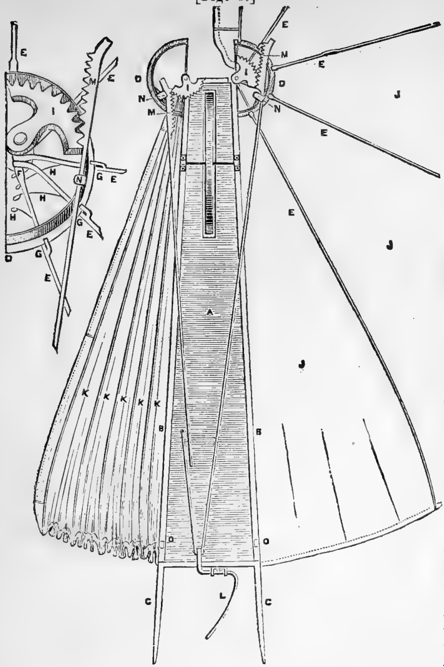
I have seen the model, but am not favorably impressed with the machine as one having any great practical value. The spring bumper is an expensive and unnecessary addition, and in other respects the machine is inferior in utility to that I have just described. One good feature, however, is an arrangement for closing up the tree-way where the bumper touches the tree. It consists simply of two long strips of sheeting fastened to a light frame, each one of which is so attached to the sides of the tree-way that when dropped they form a roof as at Figure 5. The tree easily separates these two pieces when the machine is worked. The frame of this machine is quite flat with an upturned rim, but each half-circle is so arranged that it can be raised on hinges.

Dr. M. M. Hooten, of Centralia, Illinois, patented last summer a machine made very much after Dr. Hull's plan, but he has since made several improvements and changes and has made application for another patent for the improved machine which I herewith illustrate from a model with which he has kindly furnished me.

He first constructs a long narrow wheel-barrow with a level and smooth platform (Fig. 6, *a*,) made of ½ inch pine or other light material, firmly nailed down to two arms (*b*, *b*,) and covering them from the front end to within twenty inches of the rear end. These rear ends serve for handles (*c*, *c*). The anterior ends, at a point one foot from the extremity, rest upon the axles of the wheel, which is two feet in diameter. He then attaches a half circle (*d*, *d*) to each outer side of the forward ends of the arms of the platform. These half circles are ten inches in diameter, and are so placed as to be about two-thirds of their width in advance of the platform, which at the forward end is from ten to twelve inches wide. Thus enough room is left for the tree to be admitted between the flat sides of the half circles.

There are now to be five or six movable arms (*e*, *e*) placed on each side of these iron half circles, and a single half-inch bolt (*f*) passed through a hole in the inner ends of them, and through the straight bar next to the tree-way. The arms are now permitted to rest on the half circles, and are held down to the circle by a hook

[Fig. 6.]



which is attached to the lower side of the arm and curves over the outside of, and under, the circle (g, g).

These movable arms are now arranged at equal distances on the circles, and fastened with twine, while the canvas is being tacked on, beginning first by tacking it to the sides of the platform of the barrow and then to the arms. At the inner end of each of these movable arms is a raised finger (h, h), which holds the canvas up so as to keep any insects from being thrown over into the tree-way. A semi-circular cog-wheel (i, i), which works by its centre, is now placed on the lower end of the same bolt that passes through the inner ends of the movable arms. The forward arm on each side is firmly attached to this cog-wheel, which works under the canvas. When made to revolve backwards or forwards on the bolt, this cog-wheel carries the outside arm around on the iron half circle, and the sheet-covered frame is thus easily stretched and opened, as at j, j, or closed as at k, k.

This motion is quickly accomplished by means of a lever (l), which works on a hinge at the rear of the platform, and which moves a rod armed on one side at the forward end with cogs (m, m), which tread in the cogs of the semi-circular cog-wheel before described, to which it is held by a keeper (n). The handle of the lever lies on the platform when the machine is folded, and stands upright when it is extended; so that by a single motion of one hand of the operator, the machine may be folded into a very small compass, or as quickly extended. The hinder part of the machine is supported by two swinging legs (o, o). These may swing back to the handles, but cannot go forward beyond a right angle. The machine is very light, and works so easily that, according to the inventor, a boy of fourteen years can

easily run one of them. The whole machine does not weigh over forty pounds.

The above figure represents a back view of the machine, with one side open and the other closed. The principle advantage of the machine lies in this folding apparatus, which enables the operator to defy the wind which on some days renders the original Hull machine almost useless as it plays powerfully against the stretched canvas. This feature also enables the owner to store the machine away with less trouble. I have my doubts, however, whether the advantage gained sufficiently compensates for the extra machinery. Another advantage which Mr. Hooton claims for the machine is that it is so low that it will swing its broad folds under low-headed trees. That portion of the wheel which rises above the platform is protected by a circular box, and it is found that every time the canvass is expanded, there is a slight jerk, which casts everything that has fallen upon it to the centre, where the bugs and fruit consequently remain until removed. The raised fingers to which the canvas is attached at the centre, and similarly raised pieces along each side of the tree-way, prevent the insects and fallen fruit from escaping; and there is no receptacle below into which they can be brushed. The machine is therefore built with the idea that it is as easy to pick up and remove the fallen beetles and fruit as it is to brush them into a receptacle below.

In operating the machine it is wheeled up to the tree while closed, then expanded and drawn back a little so as to give the tree a jar, and then closed and wheeled away to the next tree. Mr. Hooton has had a full sized machine in operation, and it seems to give very good satisfaction. As there is considerable casting needed, the ordinary fruit-grower will not be able to manufacture it as easily as he can the Ward machine; but as all these machines will doubtless be put upon the market the coming season, the reader must choose for himself which he prefers.

I have been urged to take an interest in two of these machines, and even to take out a patent for certain improvements suggested; but as a public officer I have refused to do either. My object is to give a disinterested and candid account of what I conceive to be the merits or demerits of any machine that may appear, in the hope that ere long we shall have something in the market, so cheap and efficient that no peach-grower will have any excuse for not jarring his trees.

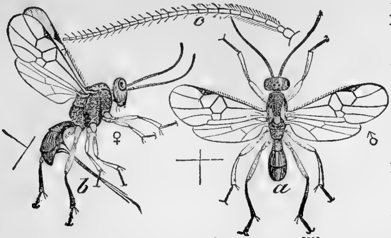
TWO TRUE PARASITES OF THE PLUM CURCULIO.

THE SIGALPHUS CURCULIO PARASITE.

Just 10 years ago, in his "Address on the Curculio," delivered at the annual meeting of the N. Y. State Agricultural Society, Dr. Fitch gave an account, accompanied with a figure, of a small Ichneumon-

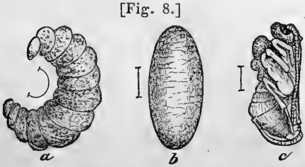
fly which he named *Sigalphus curculionis*, and which he believed was parasitic on the Curculio. Before that time no parasite had ever been known to attack this pestilent little weevil, and even up to the present time it is currently believed that no such parasite exists; for unfortunately the evidence given by Dr. Fitch was not sufficient to satisfy some of our most eminent entomologists. These parasites were in fact received by him from Mr. D. W. Beadle of St. Catherines, C. W., who had bred them from Black-knot, from which he bred at the same time a certain number of Curculios; but as other worms besides those of the Curculio are likewise found in Black-knot, we had no absolute proof that this fly was parasitic on the insect in question. Consequently we find that Mr. Walsh, in his Report as Acting State Entomologist of Illinois, rather ridicules the idea of its being a Curculio parasite and endeavors to prove that it is parasitic instead on the larva of his Plum Moth (*Semasia prunivora*). But I have this year not only proved that poor Walsh was himself wrong in this particular inference, but that he was equally wrong in supposing his little Plum-moth, so called, to be confined to plums; for I have bred it from Galls (*Quercus frondosa*, Bassett); from haws, from crab apples and abundantly from tame apples.

[Fig. 7.]



To be brief, Dr. Fitch's *Sigalphus* is a true parasite on the Plum Curculio and I have bred hundreds of the flies from Curculio larvæ. The first bred specimens gave me much pleasure, for as soon as I saw they belonged to the same genus as Dr. Fitch's fly, I felt assured that another disputed question was settled. But to make assurance doubly sure, I repeatedly half filled large jars with pure earth, finely sifted so that no living animal remained in it. Into these jars I placed Curculio larvæ from day to day as they issued from peaches that were thrown into another vessel, and in due time the parasitic flies began to issue from the ground along with the perfect Curculios. Nay more than this, I soon learned to distinguish such Curculio larvæ as were parasitised, and after they had worried themselves under the ground—seldom more than half an inch—I would uncover them, and on several occasions had the satisfaction of watching the gnawing worm within reduce its victim until finely nothing was left of him. As soon as the Curculio larva is destroyed by the parasite, the latter (Fig. 8, *a*) encloses itself in a tough little yellowish cocoon of silk (Fig. 8, *b*), then gradually assumes the pupa state (Fig. 8, *c*) and at the end of about the same length of time that the Curculio

[Fig. 8.]



requires to undergo *its* transformations and issue as a beetle, this, its deadly foe, gnaws a hole through its cocoon and issues to the light of day as a black four-winged fly (Fig. 7, *a male ; b female*). In the vicinity of St. Louis, this fly was so common the past season that after very careful estimates, I am satisfied three-fourths of all the more early developed Curculio larvæ were destroyed by it. On the 17th and 18th of April, in that locality a severe frost killed the peach buds on all but a few of the young and most vigorous trees of Hale's Early and Crawford, so that instead of a large and abundant crop of peaches to depredate on, the little Turk had to concentrate its attacks on the few peaches that were left; and no one expected that any fruit would be saved. Yet the work of this little parasite was so effectual that, wherever fruit set, a fair crop was gathered even by those who made no effort at all to protect their trees!

While visiting Dr. Fitch last August, at his house in Salem, N. Y., I compared my bred specimens with his species, and found them identically the same; but a full description of it will be found below, and it is not necessary at present to dwell upon its characters.

As Mr. Walsh bred this same parasite from the larvæ of his little Plum Moth, it doubtless attacks other soft-bodied larvæ and does not confine itself to the Plum Curculio. This is the more likely as it would scarcely pass the winter in the fly state. The female, with that wonderful instinct which is exhibited in such a surpassing degree in the insect world, knows as well as we great Lords of Creation what the little crescent mark upon a peach or plum indicates; and can doubtless tell with more surity, though she never received a lesson from her parents, whether or not a Curculo larva is drilling its way through the fruit. When she has once ascertained the presence of such a larva by aid of her antennæ—which she deftly applies to different parts of the fruit, and which doubtless possess some occult and delicate sense of perception, which, with our comparatively dull senses, we are unable to comprehend—then she pierces the fruit, and with unerring precision, deposits a single egg in her victim, by means of her ovipositor.

Now there is, as I shall show in the description, a variety (*rufus*) of this parasite, with the ovipositor nearly one-fifth of an inch long, but in the normal form the ovipositor is only twelve-hundredths of an inch long, and the Curculio larva must therefore be reached soon after it hatches, or while yet very young. Consequently we find that the earliest Curculio larvæ, or those which hatch while the fruit is yet small, are the most subject to be parasitised, and while from larva obtained early in the season, I bred more parasites than Curculios, this order of things was reversed a little later in the year. Some persons will no doubt wonder how such a large fly can be developed from a Curculio larva which is stung while so young; but we do not know how long the parasitic egg remains unhatched, and it must be re-

membered that it is a rule, wisely ordained and long known to exist in insect life, that the parasitic larva does not at first kill outright, but subsists, without retarding growth, upon the fatty portions of its victim, until its own growth is attained. Thus the first worm derives its nourishment from the juicy fruit, and grows on regardless of the parasite which is consuming its adipose substance, until the latter is sufficiently developed, and the appointed time arrives for it to destroy its prey by attacking those parts more vital.

This parasite, which I will now proceed to describe, belongs to the second sub-family (*Braconides*) of the Ichneumon-flies (*Ichneumonidæ*), and the venation of its wings, and 3-jointed abdomen, place it in the genus *Sigalphus*. Westwood (Synopsis, p. 63) gives three cubital panes or areolets in the front wings as characteristic of the genus; but Brullé (p. 510) and, as Mr. Cresson informs me, Westmael in his *Braconides de Belgique*, give only two, which is the number in our insect.

SIGALPHUS CURCULIONIS, Fitch—*Imago*—(Fig. 7, *a* male; *b* female). *Head* black, sub-polished and sparsely covered on the face with short whitish hairs; ocelli touching each other; labrum and jaws brown; palpi pale yellow; antennæ (Fig. 7, *c*) 27-jointed, filiform, reaching, when turned back, to middle joint of abdomen or beyond, the bulbus and small second joint rufous and glabrous, the rest black or dark brown, though 3–10 in many specimens are more or less tinged with rufous; 3–14 very gradually diminishing in size; 14–27 sub-equal. *Thorax* black, polished, the metathorax distinctly and broadly punctate, and the rest more or less distinctly punctate or rugose, with the sides sparsely pubescent. *Abdomen* pitchy-black, flattened, the dorsum convex, the venter concave, and the sides narrow-edged and slightly carinated; the three joints distinctly separated and of about equal length; the first joint having two dorsal longitudinal carinæ down the middle; all densely marked with very fine longitudinally impressed lines, and sparsely pubescent; (Dr. Fitch in his description published in the *Country Gentleman*, under date of September, 1859, states that these lines leave "a smooth stripe along the middle of its second segment and a large smooth space on the base of the third;" which is true of a few specimens, but not of the majority, in which the impressed lines generally cover the whole abdomen.) Ovipositor longer than abdomen, but when stretched in a line with it, projecting backwards about the same length beyond; rufous, with the sheaths black. *Legs* pale rufous, with the upper part of hind tibiæ aud tarsi, and sometimes the hind femora, dusky. *Wings* subhyaline and iridescent, the veins pale rufous, and the stigma black. Length ♀, 0.15–0.16 inch, expanse 0.30; ♂ differs only in his somewhat smaller size and in lacking the ovipositor. In many specimens the mesothorax and the eyes are more or less distinctly rufous.

Described from 50 ♀♀, 10 ♂♂, bred June 23d–July 29th, 1870, from larvæ of *Conotrachelus nenuphar*, and 2 ♀♀ obtained from Dr. Fitch.

Larva (Fig. 8, *a*)—White, with translucent yellowish mottlings.

Pupa (Fig. 8, *c* ♀)—0.17 inch long; whitish, the members all distinct, the antennæ touching hind tarsi, the ovipositor curved round behind, reaching and touching with its tip the third abdominal joint, which afterwards forms the apical joint of imago; five ventral joints, which in the imago become much absorbed and hidden, being strongly developed.

Cocoon (Fig. 8, *b*)—Composed of one layer of closely woven yellowish silk.

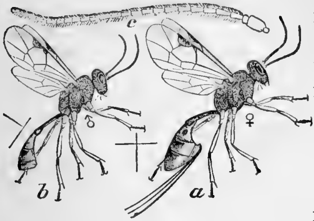
VARIETY RUFUS—Head, thorax and most of first abdominal joint entirely rufous, with the middle and hind tibiæ dusky, and the ovipositor three times as long as abdomen and projecting more than twice the length of the same beyond its tip.

Described from three ♀♀ bred promiscuously with the others. This variety is slightly larger and differs so remarkably from the normal form that, were it not for the absolute correspondence in all the sculpturing of the thorax and body, and in the venation of the wings, it might be considered distinct. The greater length of the ovipositor is very characteristic, and accompanies the other variation in all three of the specimens.

THE PORIZON CURCULIO PARASITE.

The other parasite works in very much the same manner, but instead of issuing the same summer as a fly, it remains in its somewhat tougher and more yellowish cocoon all through the fall and winter, and does not issue in the winged state till the following spring. This parasite was first discovered by Dr. Trimble, who sent me the cocoons from which I subsequently bred the perfect fly. It belongs to the first sub-family (*Ichneumonides*) of the Ichneumon-flies, and apparently to the genus *Porizon** of which it forms a new species. It is only necessary here to state that it differs from the other species in its reddish-brown abdomen, as well as in form, as may be readily seen by referring to the figures (Fig. 9, *a* female; *b* male; *c* antenna).

[Fig. 9.]



PORIZON CONOTRACHELI, N. SP.—*Head* pitchy-black, opaque, the ocelli triangularly placed and close together; eyes oval, polished, and black; face covered with a silvery-white pubescence; labrum rufous, with yellowish hairs; mandibles and palpi, pale yellowish-brown; antennæ inserted in depressions between the eyes, reaching to metathorax when turned back, filiform, 24-jointed; black with basal joints 6–1 becoming more and more rufous, the bulbus always distinctly rufous; bulbus rather longer and twice as thick as joint 3; joint 2 about one-third as long. *Thorax* pitchy-black, opaque, the sides slightly pubescent with whitish hairs, the mesothorax rounded and bulging anteriorly, the scutellum slightly excavated and sharply defined by a carina each side; metathorax with the elevated lines well defined and running parallel and close together from scutellum to about one-fourth their length, then suddenly diverging and each forking about the middle. *Abdomen* glabrous, polished, very slender at base, gradually broader and much compressed from the sides at the apex which is truncated; peduncle uniform in diameter and as long as joints 2 and 3 together; joints 2–5 subequal in length; color rufous with the peduncle wholly, dorsum of joint 2, a lateral shade on joint 3, and more or less of the two apical joints superiorly, especially at their anterior edges, black; venter more yellowish: ovipositor about as long as abdomen, porrect when in use, curved upwards when at rest, rufous, with the sheaths longer and black. *Legs,* including trochanters and coxæ uniformly pale yellowish-brown with the tips of tarsi dusky. *Wings* subhyaline and iridescent, with veins and stigma dark brown, the stigma quite large, and the two discoidal cells subequal and, as usual in this genus, joining end to end, but with the upper veins which separate them from the radial cell, slightly elbowed instead of being straight, thus giving the radial cell a quadrangular rather than a triangular appearance. ♂ differs from ♀ only in his somewhat smaller size and unarmed abdomen. Expanse ♀ 0.32 inch, length of body, exclusive of ovipositor 0.22; expanse ♂ 0.28, length 0.18.

Described from 3 ♀ ♀, 1 ♂ bred May 26th–28th, 1870, from cocoons received from Dr. I. P. Trimble, of New Jersey, and 1 ♀ subsequently received from the same gentleman—all obtained from larvæ of *Conotrachelus nenuphar*.

"But of what use are these parasites?" say you! Well, they can not, it is true, be turned to very practical account, because they are not sufficiently under our control; but it is a source of great satisfaction to those who have been looking for many years for some natural aid to help them in the artificial warfare waged against the Curculio,

* As I am informed by Mr. E. T. Cresson, of Philadelphia, who pays especial attention to the classification of the *Ichneumonidæ,* it might more properly be referred to Holmgren's genus *Thersilochus,* which differs from *Porizon* in the greater distance between the antennæ at base, and in the venation of the wing.

to know that besides its several cannibal foes, there are at last two true parasites which attack it. Indeed, with the knowledge of the Curculio enemies figured and described two years ago in the *American Entomologist*, and of the egg-destroying *Thrips* which I mentioned last year in a paper published in the Illinois State Horticultural Transactions for 1869 (p. 90), and these two parasites, the grower of our luscious stone-fruits may with good reason begin to hope for better days, for the prospect brightens. There is no philosophy in the statement of Mr. W. B. Ransom,* that we can never hope for assistance from parasites, because, as he confidently expresses it, "there are none at present but what have always existed!" Such argument will do for the believers in the old-school doctrine, that every thing was created just as we find it; but not for those who rightly comprehend the Darwinian hypothesis of development, and who believe that life is slowly undergoing change and modification to-day just as it ever has since it had an existence on this Earth. For my own part, nothing has ever appeared more absurd than the direct creation of something out of nothing, and I would as soon believe that we all dropped full grown from the clouds—instead of being brought into the world by natural means and gradually developing into manhood and womanhood—or that we have the same habits as our barbarous ancestors had; as to believe that the animal life about us is now as it was in the beginning! Therefore, though these Curculio parasites may have existed in this country long ere the white man first beheld its shores, yet they may only have acquired the habit of preying upon the Curculio within the last comparatively few years. Moreover, much benefit may be derived from their artificial propagation and dissemination, and—utopian as the scheme may appear —I intend next year, *Deo volente*, to breed enough of the first mentioned species to send at least a dozen to every county seat in the State, and have them liberated into some one's peach orchard.

THE APPLE CURCULIO.—*Anthonomus quadrigibbus*, Say.

"Prove all things; hold fast that which is good!"

This injunction of St. Paul applies with just as much force to us to-day, as it did in centuries past to the Thessalonians. In what has been said above about the Plum Curculio, we have had abundant opportunity of testing the soundness of the old proverb, and in ascertaining the history of the Apple Curculio, which I am about to give, it was very necessary to bear the advice in mind. It often takes years to undo the assertions of men who are in the habit of talking glibly of

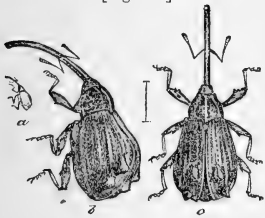
* *Prairie Farmer*, June 4th, 1870.

that which they really know nothing about, and I ought to comment severely on what has been said about this insect; but I refrain from doing so, in this case, lest it be said that my words are prompted from personal considerations.* I shall therefore content myself with a plain narrative of this insect's habits.

First then, let us explain the differences between the perfect states of this insect and the Plum Curculio, that any one may distinguish between them.

The snout of the Plum Curculio hangs down like the trunk of an elephant; it is short, stout, and does not admit of being stretched out horizontally forwards; and as may be seen by referring to the figure (Fig. 1, *c*) is scarcely as long as the head and thorax together, and can be folded back between the legs, where there is a groove to receive it. The Plum Curculio is broadest across the shoulders and narrows behind, and moreover, the black sealing-wax-like, knife-edged elevations on the back, with the pale band behind them, characterize it at once from all our other fruit boring snout-beetles.

[Fig. 10.]



The Apple, or Four-humped Curculio (Fig. 10, *a*, natural size; *b*, side view; *c*, back view,) is a smaller insect with a snout which sticks out more or less horizontally and can not be folded under, and which in the male is about half as long, and in the female is fully as long as the whole body. This insect has narrow shoulders and broadens behind, where it is furnished with four very conspicuous humps, from which it takes its name. It has neither the polished black elevations nor the pale band of the Plum Curculio. In short, it differs generically, and never attacks stone fruit.

The size varies from 1-20th to nearly 1-12th of an inch, but the colors are quite uniform, the body being ferruginous or rusty-brown often with the thorax and anterior third of the wing-covers ash-gray —the thorax having three more or less distinct pale lines.

ITS NATURAL HISTORY.

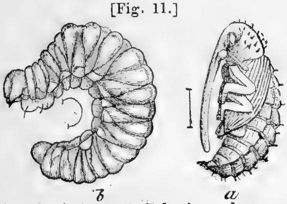
This beetle like the Plum-weevil is a native American insect, and has from time immemorial fed on, and bred in, our wild crabs. It is also commonly met with on the Thorn, and Mr. Wm. Saunders, of London, C.W., tells me that though abundant on the last named tree, it has not yet learned to attack the apple in his locality. It eventually learned to like our cultivated apples and pears, and is also found on quinces. At present it does considerable damage to the crop in some localities, though it yet prefers the wild to the cultivated fruit. Like

* My views on this subject, with comments on what has been said about this insect, may be found in a controversy, in articles published in the *American Entomologist and Botanist*, Vol. II, pp. 225–7 and 268–71; the *Prairie Farmer*, July 16th, 23d and Aug. 27th, 1870; and the *Journal of Agriculture*, Oct. 13th, and Nov. 10th and 17th, 1870.

the Plum-weevil also, it is single-brooded, and winters over in the beetle state, though I was led to believe differently a year ago. With its long thin snout it drills holes into the fruit, much resembling the puncture of a hot needle, the hole being round, with a more or less intense black annulation. and an ash-gray centre. Those holes made for food are about one-tenth of an inch deep and generally scooped out broadly at the bottom in the shape of a gourd. Those which the female makes for her eggs are scooped out still more broadly and the egg at the bottom is often found larger than the puncture at the orifice —thus indicating that it swells from absorption, by a sort of endosmosis, of nutritive fluid from the surrounding fruit, just as the eggs of many saw-flies and of some other snout-beetles are known to do.

The egg is fully 0.04 of an inch long, nearly oval, not quite three times as long as wide, and of a yellowish color, with one end dark and empty when the embryo larva is well formed. The egg-shell is so very fine that the larva seems to gradually develop from it instead of crawling out of it; and by taking a matured egg and gently rolling it between the thumb and finger, the young larva presents itself, and at this early age its two little light brown mandibles show distinctly on the head. As soon as this larva hatches it generally goes right to the heart of the fruit and it feeds there around the core, producing much rust-red excrement, and acquiring a tint of the same color. It feeds for nearly a month, and when full grown presents the appearance of Figure 11, *b*.

[Fig. 11.]



It differs so remarkably from that of the Plum Curculio that the two insects can be distinguished at a glance even in this masked form. It is softer, the chitinous covering being thinner and much whiter. It cannot stretch straight and travel fast as can that of the Plum Curculio, but curls round with an arched back, joints 4–7 being larger than the preceding. It is more crinkled, each joint being divided into three principal folds much as in the common White Grub. The space between the folds is frequently bluish-black, and there is a very distinct, continuous, vascular, dorsal line of a bluish color. It has no bristles like *nenuphar* except a few weak ones on the first joint, arising from some ventral tubercles which remind one of feet. The head is yellowish-brown with the jaws somewhat darker, and the breathing pores, except that in the fold of the first joint, are not easily seen.

IT TRANSFORMS IN THE FRUIT.

The fruit of the wild crab containing this larva never falls, and the fruit of our cultivated apples seldom; and in this respect the effect of its work differs remarkably from that of the Plum Curculio,

or even of the Codling Moth. Why such is the case it would be difficult to explain! It is one of those incomprehensible facts which at every turn confront the student of Nature's works. We might with equal reason ask why it is that of the two stone fruits, the plum and the cherry, the larger falls and perishes and the smaller hangs on and lives, when infested with the Plum Curculio; and of the two pomaceous fruits, the apple and the haw, the larger likewise falls and perishes and the smaller hangs on and lives, when infested with similar larvæ? Most persons would naturally infer that the larger instead of the smaller fruits would best resist the injurious gnawings of the worm within; and though we may explain away the paradox by supposing that the longer stem of the smaller fruits prevents the injury from reaching its juncture with the branch, so readily as it does through the shorter stem of the larger fruits; or that the greater weight of the larger fruit causes it to fall so readily; yet this is only assuming, and I doubt whether the vegetable pathologist will ever be able to show the peculiarities of the fruits which cause the different effects.

The larva of the Apple Curculio has no legs and is so hump-backed that it cannot stretch out, and would cut a very sorry figure in attempting to descend the tree. Therefore, as the fruit containing it mostly hangs on the tree, the insect is effectually imprisoned. But Nature's ways are always ways of wisdom and her resources are inexhaustible! Consequently we find that instead of having to go under ground to transform, as does the Plum Curculio, the normal habit of our Apple Curculio is to transform within the fruit. The larva, after becoming full fed, settles down in a neat cavity, and soon throws off its skin and assumes the pupa state, when it appears as at Figure 11, *a*. After remaining in this state from two to three weeks it undergoes another moult and the perfect beetle state is assumed. We thus see that the Apple Curculio is cradled in the fruit in which it was born till it is a perfect beetle, fully fledged, and ready to carry out the different functions and objects of its life. In other words, it never leaves the fruit, after hatching, till it has become a perfect beetle. This fact I have fully tested by breeding a number myself both from infested crabs which I collected, and from cultivated apples, also infested, that were kindly forwarded to me by Mr. J. B. Miller, of Anna, Illinois. I learn also from Mr. George Parmelee of Old Mission, Michigan, that he has satisfied himself of the same trait in the natural history of this insect, and I fully convinced myself that such was the normal habit, by repeatedly removing the full grown larva from the fruit and placing it on the surface of the ground, when, in every instance, it would make no attempt to bury itself, but would always transform on the surface.

THE AMOUNT OF DAMAGE IT DOES.

The observations that I have been able to make on this insect's work in our cultivated orchards are limited, but I think that it attacks with equal relish both summer and winter apples. Whenever a beetle has perfected in the fruit, it cuts quite a large hole for its escape, and these holes are sufficiently characteristic to enable one who has paid attention to the matter to tell with tolerable certainty whether an apple has been infested with Apple-worm, Plum Curculio, or Apple Curculio—even after the depredator has left.

In the southern portion of Illinois and in some parts of Missouri this insect is very abundant and does much damage to the apple crop; it occurs in greater or less numbers in most States of the Union, but in other localities again its work is scarcely ever seen, and I am satisfied that the damage it does has been much overrated. We can only judge of the future by the past, and though we may expect this insect to increase somewhat with the increase of our orchards, it is folly to suppose that it can go on increasing in geometrical ratio; and the pretty mathematical calculations which are intended to alarm the cultivator at the gloomy prospects of the future, are never made by those who understand the complicated net-work in which every animal organism is entangled, or who rightly understand the numerous influences at work to keep each species within due bounds. Such figures look well on paper, but, like air-castles, there is nothing real about them.

Our apples suffer much more, in many localities, from the gougings of the perfect beetle and the burrowings of the larva of the Plum Curculio, than they do from the work of this Apple Curculio; and this was so much the case in my own locality the past summer, that I found a dozen larvæ of the former in apples, where I found one of the latter.

At the late meeting of the Illinois State Horticultural Society, Mr. E. Daggy, of Tuscola, Illinois, had on exhibition some pears that were very much deformed and gnarled. This injury had been caused by the Apple Curculio, which Mr. Daggy recognized from figures and specimens which I had with me. Upon examining the pears I found a little dark circular spot which indicated distinctly where the snout of the beetle had been inserted. This spot was the center of a hard and irregular but generally rounded knot or swelling, which was sunk in a depression of the softer parts of the pear, thus indicating that the growth, by some property of the puncture, was checked and hardened, while the other parts went on growing and swelling. Some of the fruit was so badly disfigured that it could no longer be recognized, and Mr. Daggy informed me that his Vicar of Winkfield, Bergamott and "Sugar" pears were most affected in this way, and that his Duchesse pears were unblemished.

While the fruit is growing these punctures, in almost every in stance, cause just such calloused spots and deformities as those des

cribed above, but when the fruit is ripe they have a far more pernicious effect, for they generally cause the fruit to rot. It is now a well established fact that the common Plum Curculio causes the dreaded rot in peaches, plums, etc., to spread at a fearful rate by the punctures and gougings which it makes on the ripening fruit; and that where this predisposing influence is guarded against, such rot is generally confined to comparative narrow limits or does not occur at all. Many varieties of apples are disposed to rot in a similar manner, and to fall from the tree just as they are ripening. This rot in apples, as may be seen from the transactions of our State Horticultural Society, was very prevalent last fall—the Rawles Janet being especially predisposed to it—and there can be no doubt but that the punctures and gnawings of the little Turk, combined with those of the Apple Curculio are likewise the pricipal agents in producing it; for I have over and over again noticed the rot to spread in a circle from these punctures, not only on hanging fruit but just as invariably upon fruit punctured after it was plucked. Whether we believe that the fungus growths, often noticeable on such rotting fruit, are the direct result of the punctures, or that the latter only act indirectly by furnishing a proper nidus for the infectious fungus-spores which are supposed to be ever floating in the atmosphere, is a question which I shall not now stop to consider, though I have my own views which are somewhat heterodox. In either case, the Curculios are just as much to blame, and this should be an additional incentive to a general warfare upon them. Judge A. M. Brown, of Villa Ridge, has noticed that some varieties of apples are much more subject to rot and also more subject to the attacks of Curculios than others,* and it is to be hoped that he will make further observations and give us a reliable list of such varieties, and that other fruit-growers will do the same.

THE SEASON OF THE YEAR DURING WHICH IT WORKS.

The beetles come from their winter quarters and begin to work on the fruit at about the same time as does the Plum Curculio—if anything, a little later. They have generally got fully to work, and larvæ may be found already hatched by the first of June, and they may be found in the fruit, in one stage or another, all along through the months of June and July and the greater part of August.

REMEDIES AND PREVENTIVE MEASURES.

Notwithstanding we have had reports, published in the columns of our agricultural papers, of the relative number of Apple and Plum Curculios captured from peach trees by jarring with the Curculio-catcher, I am fully convinced that such reports were not based on facts, and that we may never expect to subdue this insect by the jarring process. It is not as timid or as much inclined to drop as the Plum Cur-

*Prairie Farmer, January 28, 1871.

culio, and though it can occasionally be brought down, it generally remains defiantly on the fruit or on the bough, through the gentlest as well as the severest jarring of the tree. Indeed, its habit of transforming in the fruit, places it in a great measure beyond our control, and I fear that this is one of the few insects with which we can do but little by artificial means. But we have only just commenced to understand this foe, and there is much yet to learn about it. I sincerely hope that the few facts which have been here given, will increase the reader's interest in this insect and enable him to carry on future observations and experiments with a better understanding; so that they will at last result in making us masters of this rather difficult situation. Mr. H. Lewelling, of High Hill, Montgomery county, Missouri, who has had much of his fruit injured by this insect, informs me that Tallman's Sweet is preferred by it to all other varieties, and our observations should, as much as possible, tend in the direction of deciding which varieties are most subject to, and which most exempt from its attacks; and which varieties fall most readily when infested by it. For it is obvious that with our present knowledge, the only real remedy which yet exists, is the destruction of the infested fruit, whether upon or off the tree; and it may turn out that although we cannot jar down the beetles, we can jar down much of the infested fruit, which would, without jarring, remain on the trees.

ANTHONOMUS QUADRIGIBBUS, Say—*Larva* (Fig. 11, *b*)—Average dorsal length when full grown 0.45 inch; soft and white, with a very few sparse soft hairs; arched and wrinkled Lamellicorn-fashion, the space between the wrinkles, and a distinct dorsal vascular line, bluish-black. Head free and almost perpendicular, yellowish-brown with the mandibles darker. A pair of polished ventral tubercles on each of the three thoracic joints, and each bearing a distinct bristle.

Pupa (Fig. 11, *a*)—Average length 0.40 inch. Whitish, the snout of ♀ reaching beyond tip of wing-cases, that of ♂ not much beyond the elbow of middle femora and tibiæ. Thorax with a few short stiff hairs springing from slight conical elevations. Wing-cases showing the striæ and humps of future beetle, the tip of the upper case usually terminating in a thorn. The nine abdominal joints deeply and distinctly separated, the first showing a rounded scuttellar turbercle; the sides angular, conically ridged and armed on each joint with two brown thorns or bristles, which become stouter towards apex; a transverse dorsal row of about eight similar bristles on the posterior sub-margin of each joint, also becoming larger towards apex: Terminal sub-segment ending in *one* stout, slightly curved, thorn.

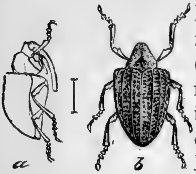
THE QUINCE CURCULIO—*Conotrachelus cratægi*, Walsh.

HOW IT DIFFERS FROM THE OTHERS.

This insect has been called the Quince Curculio by Dr. Trimble, and though it breeds in other fruits, the name is a good one as it will enable us to distinguish it at once from our other fruit snout-beetles. I have had the beetle in my cabinet for several years, but knew nothing of its larval history till a year ago last fall. It breeds very abundantly in our common haws, and I raised a number of them the pres-

ent season from the fruit of the Pear or Black Thorn (*Cratægus tomentosa*) obtained from Mr. Walsh.

[Fig. 12.]



Though belonging to the same genus as our Plum Curculio, and having very much the same form, as may be seen by referring to the figure, (Fig. 12, *a* side view; *b* back view), yet it differs remarkably in its habits from both of the preceding weevils. It is, like them, an indigenous species, and its original fruit was evidently the wild Haw, which in the West it yet seems to prefer to the cultivated fruits. But in the East it has become very injurious to the Quince and, as we might naturally expect, also attacks the Pear, and especially the Lawrence and other late varieties. In September, 1868, I received specimens from W. W. Sweet, of Highstown, N. J., with the statement that they were found on pears, and Dr. Trimble at a late meeting of the New York Farmers' Club (Oct. 22, 1870), gave the following account of its injuries in New Jersey the present year:

"Yesterday five or six hundred were taken from the bottoms of two barrels of quinces, although those quinces had only been gathered four days before. A friend of mine has a quince orchard of 286 trees. These trees this season should average seventy or eighty quinces to a tree, making more than twenty thousand. Upon a most careful search I was unable to find one specimen perfect, or clear of one or more blemishes caused by the punctures of this insect. Frequently four, five, or six grubs will be found in a single quince. Mr. Goldsmith, the owner, keeps this orchard in first-rate order; he has faithfully kept out the borers, so fatal to the quince trees; has fertilized very freely, and the cultivation is perfect. He told me yesterday, that his crop this year is thirty barrels, which will yield him about $125. Had this insect let him alone he should have had at least 100 barrels, worth $800 to $1,000. Many of his later pears, including the Seckel and Lawrence, have suffered greatly, though not to the same extent as his quinces. A few days ago he emptied a barrel of cullings, chiefly Lawrence pears, and in and near the bottom of that barrel were found at least 400 of these grubs. A month ago I visited the orchards attached to one of the best nurseries in Pennsylvania, and I found the sad evidence of the presence of this enemy. Even the Seckel pears, though very abundant, were almost worthless; later varieties still worse. Mr. Fuller tells me that he has seen this season, in Western New York, the same condition of fruit at a well known nursery, even the Duchesse pears almost totally destroyed. This fruit enemy seems yet confined to localities; but is spreading rapidly."

This beetle was first very briefly described by Mr. Walsh in a note in the *Prarie Farmer* for July 18th, 1863, p. 37, from specimens found by him on the hawthorn, but until I bred it this spring, nothing was known of its larval history. It is a somewhat larger insect than the Plum Curculio, has a comparatively longer snout, and is very broad-shouldered; thus tapering just the opposite way to the Apple Curcu-

lio. Its general color is a tolerably uniform ash-gray, mottled more or less with ochre-yellow, dusky and whitish, and it has a dusky somewhat triangular spot at the base of the thorax above, and seven distinct narrow longitudinal elevations on the wing-covers, with two rows of punctures between each.

This beetle differs further from the others, in the fact that it does not appear, even in the latitude of St. Louis, till about the first of June, and I have had its larvæ of the previous year in the ground in May, when the newly hatched larvæ of the Plum Curculio were already working destruction in the fruit. In some of the more northern States it would not appear till the middle of July.

ITS TRANSFORMATIONS AND HABITS.

This snout-beetle does not make a crescent like the Plum Curculio; but, like the Apple Curculio, makes a direct puncture for the reception of its egg, the hole being somewhat larger than that of the latter, and the bottom of the cavity similarly enlarged and gnawed, so as to form a neat bed for the egg. The egg is very similar to that of the Plum Curculio, and hatches in a few days after being deposited. In all probability it also swells and enlarges somewhat before hatching. The larva works for the most part near the surface of the fruit, and does not enter to the heart. It is of the general form of that of the Plum Curculio, and differs principally in being somewhat larger, more opaque-white, and in having a narrow dusky dorsal line and a distinct lateral tubercle on each joint. When full grown, which is in a month or more from the time of hatching, it leaves the fruit through a smooth cylindrical hole and burrows two or three inches into the ground. Here, singularly enough, it remains all through the fall, winter and spring months without changing—no matter whether it left the fruit as early as the first of August or as late as the first of October. This is the peculiar feature of the insect, namely, that it invariably passes the winter in the larva state, and does not even assume the pupa state till the fore part of May, or a few days before issuing as a beetle. In this respect it resembles the nut-weevils which infest our hickory-nuts, hazel-nuts and acorns. In higher latitudes than that of St. Louis, there is evidence that some of the late hatched larvæ do not leave the haws they infest till frost overtakes them, but pass the winter within the fruit as it lies on the frozen ground. The pupa differs only from that of the Plum Curculio in the greater length of the proboscis.

I have already referred to the fact that Dr. Fitch supposed the Plum Curculio to be two-brooded, and those who have read his "Address" on this insect will readily perceive that he based his opinion on finding what he took to be its larvæ in the tender bark of a pear twig late in the fall, and on finding what he similarly mistook for such larvæ in haws in winter. Of course, we know positively now

that the Plum Curculio does not so breed in pear twigs, and it is very evident that what Dr. Fitch took to be Plum Curculio larvæ in such a twig, were the young of some other insect, or perhaps even the eggs of some leaf-hopper (*Tettigonia*), which are generally placed in the position described by him. But, though this first error of Dr. Fitch's has been explained away, the second never has till now, when we may assume, with great reason, that the larvæ which misled the Doctor, and which were found in haws in winter time, were in reality the larvæ of our Quince Curculio. How easily are fallacies exploded, and errors corrected, even years after they are committed, by a few well tested facts!

The two former Curculios which we have been considering have a beetle existence of between nine and ten months, during most of which time, or as long as the weather is sufficiently mild, they feed in the manner described. The present species has a beetle existence of not more than two months, and as though aware of the short term allotted to it for enjoyment, it endeavors to make the best use of its time. Consequently we find it more ravenous than either of the other species, and it is really astonishing how much this insect eats. It excavates immense holes for food, often burying itself in them completely, and I have known apples furnished to these beetles in confinement, to have their substances so completely devoured that nothing but the rind was left. Two years ago last fall there was scarcely a quince that came into the St. Louis market that was not marred by numbers of large gougings, and though I was then inclined to attribute such holes to the gnawings of grasshoppers, I feel pretty well convinced at present that the work might with more justice have been attributed to this Quince Curculio.

The question will naturally arise, since this insect breeds in the Haw, the Quince and the Pear, whether it will also breed in the closely allied Apple? So far as my experiments go, they indicate clearly that it will not; for although the beetle will eat and greatly disfigure apples, when no other nourishment is at hand, yet a number which I confined to a large branch of an apple tree on the 14th of June last, absolutely refused to deposit eggs, and died three weeks afterwards.

REMEDIES.

Very fortunately this insect drops as readily when alarmed as does the Plum Curculio, and the jarring process will be found just as effectual in catching it, with the additional advantage that the jarring need only be carried on for about ten weeks of the year, namely, from about the first of June to the middle of August in this latitude. Moreover, in accordance with its late appearance, we find that, according to Dr. Trimble, whenever it attacks pears, it prefers the late ripening varieties. Again, it is, like the Plum Curculio, nocturnal

in its habits, and secretive during the day, so that the Ransom process will undoubtedly prove effectual with it, if used at the right season. All fruit that falls should be destroyed, and as we know that the larva hibernates in the ground, many of them will be injured and destroyed by late stirring of the soil.

CONOTRACHELUS CRATÆGI, Walsh—*Larva*—Average length when full grown 0.32 inch; 4½ times as long as wide, and straight. Opaque whitish, with a narrow dusky dorsal line, generally obsolete on thorax, and a few very short hairs. Distinct lateral tubercles on all the joints. Head rufous with mandibles black, except at base, and distinctly two-toothed at tip.

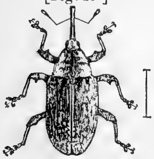
Pupa—Average length 0.28 inch. Snout reaching a little beyond elbow of middle tibiæ and tarsi, with two stout rufous thorns near the origin of antennæ, two more at base and sometimes others more toward the tip. Head and thorax also armed with such thorns, and also two to each elbow of the femora and tibiæ. Wing cases with rows of short rufous bristles along the elevations between the striæ. Abdomen cylindrical, the basal joint with a central scutellar bristleless tubercle and two others, one each side of it, each bearing a bristle; the other joints conically tubercled, laterally, each tubercle bearing a stout bristle, and each joint bearing dorsally about four other bristles on its posterior sub-margin. Terminal sub-segment squarely cut off and bearing *two* stout inwardly-curved brown thorns.

THE PLUM GOUGER.—*Anthonomus prunicida*, Walsh.

ITS CHARACTER, DISTRIBUTION, AND FOOD.

This name was given by Mr. Walsh to another indigenous weevil which is represented enlarged in the accompanying illustration (Fig. 13). It is easily distinguished from either of the preceding weevils, by its ochre-yellow thorax and legs, and its darker wing-covers, which are dun-colored, or brown with a leaden-gray tint, and have no humps at all. Its snout is not much longer than the thorax, but as in the Apple Curculio, projects forwards, or downwards but cannot be bent under as in the Plum Curculio. This insect was first described in the *Prairie Farmer* for June 13th, 1863, and the description was afterwards republished in the Proceedings of the Boston Society of Natural History for February, 1864.

[Fig. 13.]



Mr. Walsh gave such a good account of it in his report as Acting State Entomologist of Illinois, that it is unnecessary for me to go into detail, and I will therefore only briefly allude to those traits in its history which are well established.

The Plum Gouger seems to be unknown in the Eastern States, or at least is not common there; but it is very generally distributed throughout the Valley of the Mississippi. As a rule it is much less common and does much less injury than the little Turk, though in some few districts it is found equally abundant, and I received specimens on the first of June last, from my esteemed correspondent Mr.

Huron Burt, of Williamsburg, Callaway county, Mo., with the statement that it was doing great damage to the plums in that locality, though the little Turk was scarcely met with. There is a plum known there as "Missouri Nonsuch" which, though said to be Curculio proof, is worked upon very badly by the Gouger.

The Plum Gouger is often found on wild crab trees, and may, like the Plum Curculio, occasionally deposit and breed in pip fruit; but it is partial to smooth-skinned stone-fruit such as prunes, plums, and nectarines, and it does not even seem to relish the rough skinned peach.

OFTEN MISTAKEN FOR THE PLUM CURCULIO.

It has often been confounded with the Plum Curculio, and was once supposed by my friend L. C. Francis, of Springfield, Ills., to be the male of that species. We all have a right to suppose what we please, and as long as our suppositions are not thrust on the public for ascertained facts, they can do no possible harm. But Mr. J. P. Williamson, of Des Moines county, Iowa, is not satisfied with supposing this or some other straight-snouted weevil, to be the female of the Plum Curculio, but, in a last summer's issue of the *Prairie Farmer*, not only emphatically speaks of it as such, but, finding that these supposed females frequent the trees two weeks earlier than the males, (?) he concludes for some unexplained reason, that the sole object of visiting the fruit is for the deposition of eggs; and straightway hatches the theory that the Plum Curculio can do no harm till the males appear! Consequently, instead of jarring our trees as long as fruit remains on them, we are informed by Mr. Williamson that it is only necessary to jar them about six weeks.

And thus it always is with men who do not sufficiently understand the absolute importance of care and caution in reading Nature's secrets: from supposition to assumption; from assumption to theory; from theory to advice, which—it is unnecessary here to say—is of a most pernicious character.

ITS TIME OF APPEARANCE.

This beetle appears in the spring about the same time as the Plum Curculio, but as no eggs are deposited after the stone of the fruit becomes hard, and as its larva requires a longer period to mature than that of the latter, its time of depositing is shorter, and the old beetles generally die off and disappear before the new ones eat their way out of the fruit, which they do during August, September, and October, according to the latitude.

ITS NATURAL HISTORY.

Though we have no absolute proof of the fact, analogy would lead us to believe, and in my own mind there is no doubt, that this

insect passes the winter in the beetle state, and that it is, like the other species, single-brooded. Both sexes bore cylindrical holes in the fruit for food, and these holes are of the exact diameter of the snout, and consequently somewhat larger than those of the Apple Curculio. These holes are broadened at the bottom, or gouged out in the shape of a gourd; and especially is this the case with those intended by the female for the reception of an egg. The egg, in this case also, enlarges from endosmosis, and it is probable that all weevils that make a puncture for the reception of their eggs, gnaw and enlarge the bottom, not only to give the egg room to swell, but to deaden the surrounding fruit, and prevent its crushing such egg—the same object being attained by the deadened flap made by the crescent of the little Turk. Wherever this insect abounds, plums will be found covered with its holes, the great majority of them, however, made for feeding purposes. The gum exudes from each puncture, and the fruit either drops or becomes knotty and worthless.

The young larva which hatches from the egg, instead of rioting in the flesh of the plum, or remaining around the outside of the kernel, makes an almost straight course for that kernel, through the yet soft shell of which it penetrates. Here it remains until it has become full-fed, when by a wise instinct it cuts a round hole through the now hard stone, and retires inside again to change to the pupa and finally to the beetle state. When once the several parts of the beetle are sufficiently hard and strong, it ventures through the hole which it had already providently prepared for exit with its stronger larval jaws, and then easily bores its way through the flesh and escapes.

It must not be forgotten that, while the kernel of the fruit is yet soft, the larva of the little Turk often penetrates and devours it; but in this case the soft stone is more or less reduced to reddish powder, whereas the larva of the Plum Gouger enters the stone and feeds on the inside while the outside hardens. The normal habit of the former is to feed on the outside; that of the latter on the inside of the stone.

REMEDIES.

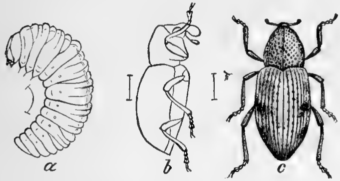
This Plum Gouger is about as hard to deal with as the Apple Curculio. It drops almost as reluctantly and we therefore cannot do much by the jarring process to diminish its numbers. Moreover it takes wing much more readily than the other weevils we have mentioned; and though fruit that is badly punctured for food, often falls prematurely to the ground, yet, according to Mr. Walsh, that infested with the larva generally hangs on the tree until the stone is hard and premature ripening sets in. In all probability the stunted and prematurely ripened fruit containing this insect will jar down much more readily than the healthy fruit, but I have so far had no opportunity of making any practical observations myself, and must conclude by

hoping that our plum-growing members will make the proper experiments and give us the results.

THE STRAWBERRY CROWN-BORER.—*Analcis fragariæ* N. sp.

This is another indigenous insect, which seems to be confined to our Mississippi Valley, for I have heard no complaints in any of the Atlantic States, of injuries that could be attributed to this weevil. In the *Maine Farmer* for July 25th, 1867, we find a brief reference, made by Mr. G. E. Brackett of Belfast, Me., in answer to a certain "E. B.," of a "worm that eats into the crown of the plant and kills it." The worm referred to was, in all probability, the Crown-borer under consideration, but as no postoffice address of the questioner is given, the paragraph might just as well never have been written, for any light that it throws on the distribution of the insect. However, no such insect has ever been mentioned by our Eastern writers on the Strawberry, and we must necessarily conclude that it does not exist in the Atlantic States.

[Fig. 14.]



This insect has done considerable damage to the strawberry crop in the southern portion of Illinois, especially along the line of the Illinois Central Railroad; and I have seen evidence of its work in St. Louis county, Mo. At the meeting of the Southern Illinois Fruit Growers' Association, held at South Pass, in November, 1867, several complaints were made by parties from Anna and Makanda, of a white worm which worked in the roots of their strawberries and in 1868, the greater portion of the plants of a ten-acre field at Anna, belonging to Mr. Parker Earle, was destroyed by it.

In the fall of 1869 I had some correspondence with Mr. Walsh on this insect, and learned that he had succeeded in breeding it to the perfect state; and had it not been for his untimely death, its history would no doubt have been published a year ago. Through the kindness of Jos. M. Wilson, of Sterling, Whiteside county, and of J. B. Miller, of Anna, Union county, Ills., I received during the past year specimens of the larvæ, from which I succeeded in rearing the perfect beetle. It is therefore by the aid of these gentlemen, and especially from the experience of Mr. Miller, that I am enabled to give the above illustrations (Fig. 14) of the Strawberry Crown-borer, and the following necessarily imperfect account of its mode of working. I give them in the hope that they will prompt further investigation, and serve as a clue to enable others who have opportunity, to in-

crease our knowledge of this pest; for there is much yet to learn of its habits, and consequently of the best means of fighting it.

From the middle of June to the middle of July in Southern Illinois, and later further north, the larva hatches from an egg which, in all probability, is deposited in the crown of the plant, and it immediately commences to bore its way downwards, into the pith. Here it remains till it has acquired its full size, working in the thick bulbous root and often eating through the more woody portions; so that when frost sets in, the plant easily breaks off and is heaved out of the ground. When full grown it presents the appearance of Figure 14, *a*, being a white grub with arched back and tawny-yellow head, and measuring about one-fifth of an inch when stretched out. It undergoes its transformations to the pupa and perfect beetle states within the root, and the latter makes its appearance above ground during the month of August.

The beetle (Fig. 14, *b* side view; *c* back view) is about 1-6th of an inch in length, of a chestnut-brown color, and marked and punctured as in the figure.

From analogy we may infer that the beetle feeds on the leaves of the strawberry, for it is a very general rule with snout-beetles, that the perfect insects feed on the leaves of such plants as they infest in the larva state. But whether it lives on through the winter as a beetle and does not commence depositing eggs again till the following June; or whether it is double-brooded and produces a second lot of larvæ which pass the winter in the roots, are questions which are not yet decided; and until we get a more comprehensive knowledge of this insect's ways and doings, we shall be in a measure powerless before it. From all the facts that can be obtained, the first hypothesis is the correct one, and in that event we can, in an emergency, easily get rid of this pest by plowing up and destroying the plants soon after they have done bearing, or say about the latter part of June in the latitude of St. Louis. By doing this the whole brood of borers will perish with the plants. Most strawberry-growers renew their plants, in some way or another, about every three years, and where this insect abounds, it will be best subdued by destroying the whole bed at the time already suggested and afterwards planting a new one; rather than by annually thinning out the old and leaving the new plants in the same bed. Here we have an effectual means of extirpating the little pest, if, as I believe, the first hypothesis is the correct one; but if the second hypothesis be correct—i. e., if the insect be double-brooded—then it will avail nothing to carry out the above suggestions, and we thus see how important it is to thoroughly understand an insect's habits in order to properly cope with it. Though we may occasionally hit upon some plan of remedying or of preventing an insect's injuries without knowing its habits, yet as a general rule we but grope in the dark until we have learned its natural history!

According to Mr. Miller, all plants infested with this larva are

sure to perish, and he has also noticed that old beds are more apt to be injured by it than new ones.

In one of the roots received from him, I found a parasitic cocoon, so that there is every reason to believe that, as is so very generally the case with insects, this noxious species has at least one natural enemy which will aid us in keeping it in due bounds. Indeed, Mr. Miller so often found this parasitic cocoon, that he at first surmised that the Crown-borer spun it. But no snout-beetle larvæ spin cocoons.

This Crown-borer must not be confounded with another white worm of about the same size which lives in the ground and subsists on the roots by devouring them from the outside. This last may always be distinguished by having six distinct legs near the head, and its habits are quite different. It occurs earlier in the season, and, as I have proved the past summer, is the larva of the little clay-yellow beetle, known as the Grape-vine Colaspis (*Colaspis flavida*, Say). A full account of this last insect, with illustrations, will be given in a later portion of this Report.

The Crown-borer belongs to the genus *Analcis* which is distinguished by its sub-cylindrical oblong-oval body, its short robust snout which fits into a deep grove, its 10-jointed antennæ, and its simple or unarmed thighs. As it is a new species I subjoin a description of it for the scientific reader:—

Analcis fragariæ, N. Sp.—*Imago*, (Fig 14, *b*, *c*)—Color deep chestnut-brown, sub-polished, the elytra somewhat lighter. Head and rostrum dark, finely and densely punctate and with short coarse fulvous hairs, longest at tip of rostrum; antennæ rather lighter towards base, 10-jointed, the scape much thickened at apex, join 2 longest and robust, 3 moderately long, 4–7 short, 8–10 connate and forming a stout club. Thorax dark, cylindrical, slightly swollen across the middle and uniformly covered with large thimble-like punctures, and with a few short coarse fulvous hairs, unusually arranged in three more or less distinct longitudinal lines; pectoral groove ending between front legs. Abdomen with small remote punctures and hairs which are denser towards apex. Legs of equal stoutness, and with shallow dilated punctures and uniform very short hairs Elytra more yellowish-brown, dilated at the lower sides anteriorly, and with about 9 deeply-punctured striæ, the striæ themselves sometimes obsolete; more or less covered with coarse and short pale yellow hairs which form by their greater density, three more or less conspicuous transverse bands, the first of which is at base; between the second and third band, in the middle of the elytron, is a smooth dark-brown or black spot, with a less distinct spot of the same color below the third, and a still less distinct one above the second band. Length 0.16 inch.

Described from four specimens bred from strawberry-boring larvæ. The black spots on the elytra are quite distinct and conspicuous on two specimens, less so on one, and entirely obsolete on the other.

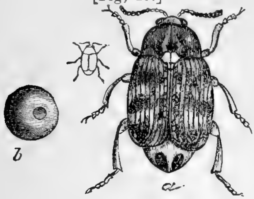
Larva, (Fig. 14 *a*)—White with back arched Lamellicorn-fashion. Head gamboge-yellow, glabrous, with some faint transverse striations above mouth; mandibles rufous tipped with black; labrum emarginate, and with palpi, pale. A faint narrow dorsal vascular line. Legs replaced by fleshy tubercles. Length 0.20 inch when stretched out.

THE PEA-WEEVIL—*Bruchus pisi*, Linn.

Our common garden pea has not many insect enemies, for with the exception of the Striped Flea-beetle (*Haltica striolata*), which

gnaws numerous small holes in the leaves, and the Corn-worm *alias* Boll-worm (*Heliothis armigera*), which eats into the pod, there are very few others besides the Pea-weevil under consideration. This species alone is so numerous, however, as to be a serious drawback to pea culture in this part of the country.

[Fig, 15.]



The term *Bruchus*, meaning a devourer, was given by the celebrated Linnæus to a genus of beetles which at first appear to have very little resemblance to the Snout-beetles. They form, however, at present, a sub-family (*Bruchides*) of the great Snout-beetle family, though they posses nearly as close affinities to the great *Chrysomela* family, and really form a connecting-link between the two. They are characterized by a depressed head and very short snout, by the antennæ being 11-jointed, straight and but slightly thickened towards the end, by the wing-covers being shorter than the abdomen, and by the rather long hind legs and much swollen thighs. Their larvæ are short, arched, and swollen in the middle, with a comparatively small head; and their depredations are confined all over the world, to leguminous or pod-bearing plants—another beautiful illustration of the "Unity of Habits" referred to on page 9.

They are far more abundant in the tropics than in more temperate climes, and in North America we have not many species to contend with. With the exception of the Honey-locust seed-weevil (*Spermophagus robiniæ*, Fabr.), which I have bred from the seeds of that tree, there are only two species, namely: the Pea and the Bean weevils that are really injurious in our State, though *Bruchus discoideus*, Say, often badly infests the seeds of *Ipomea*. A third species, however, namely, the Grain Bruchus of Europe, has lately been introduced into this country, and may some day become unduly multiplied in our midst.

The Pea-weevil is very generally dubbed "Pea-bug," but this latter term is not nearly so appropriate as the former, to which it should give way. Though everybody may notknow by sight the perfect beetle, yet every one has most assuredly seen the work of the worm, and though knowledge of the fact may not add to our enjoyment of a mess of green peas, yet the fact nevertheless remains, that those of us in the Mississippi Valley who indulge in this delicious esculent, necessarily devour a young worm with nearly every pea that we eat. Gray's oft quoted lines,

—"Where ignorance is bliss,
'Tis folly to be wise,"

Would seem to apply here with great force; but when we reflect that the diminutive and almost imperceptible worm, nourished so to speak in the very marrow of the pea, really has no flavor and produces no injurious effects on the human system; we can chuckle in

our sleeves and console ourselves with the thought that, notwithstanding the above truism, "wisdom is justified of her children." Neither this nor any other of the true weevils mentioned in this paper, can do harm when taken as food in the larva state, but there is good testimony that the hard-shell beetles are injurious when fed in a ground or unground condition, along with the seeds they infest, either to man or to other animals.

The Pea-weevil which is here well illustrated, Figure 15, *a* showing a back view, and 17, *b* a side view, the small outlines at the sides showing the natural size, is easily distinguished from all other species of the genus with which we are troubled, by its larger size, and by having on the tip of the abdomen projecting from the wing-covers, two dark oval spots which cause the remaining white portion to look something like the letter T. It is about 0.18—0.20 inch long, and its general color is rusty-black, with more or less white on the wing-covers, and a distinct white spot on the hinder part of the thorax near the scutel. There is a notch on each lateral edge of the thorax, and a spine on the under side of the hind thighs near the apex. The four basal joints of the antennæ and the front and middle shanks and feet are more or less tawny. It is supposed to be an indigenous N. A. insect, and was first noticed many years ago around Philadelphia, from whence it has spread over most of the States where the pea is cultivated. This supposition is probably the correct one though we have no means at present of proving it to be so, and certain it is that, as the cultivated pea was introduced into this country, our Pea-weevil must have originally fed on some other indigenous plant of the Pulse family. It is at present found in the more southern parts of Europe and in England, and is one of the few injurious insects which have found their way there from this country; but in accordance with the facts given in my last Report, under the head of "Imported Insects and Native American Insects," which clearly prove that our native plants and insects do not become naturalized in the Old World with anything like the facility with which those of the Old World are every day being naturalized here, this Pea-weevil does not begin to be as destructive there as it is at home.

THE FEMALE DEPOSITS HER EGGS ON THE OUTSIDE OF THE POD.

It is a very general remark that peas are "stung by the bug," and the impression prevails almost universally, not only among gardeners but with many entomologists, that the female weevil punctures and deposits her eggs *in* the pea in which the larva is to be nourished. It is a little singular that so many writers should have fallen into this error, for it is not only the accepted view amongst writers for the agricultural press, but has been adopted by many eminent entomologists, Taschenberg, Harris, and Dr. Boisduval being about the only authors who have rightly comprehended the true manner of egg-depositing. All this comes of course from one man's palming off

the opinions of another as his own, and by his adopting such opinions, whether good or bad, without due credit. Even Noerdlinger in his " Kleinen Feunde der Landwirtschaft," though he cites the excellent and original observations of Taschenberg, feels himself called upon to doubt their correctness, and himself inclines to believe that the female may put her eggs in the pea. In Packard's Guide, the eggs are erroneously said to be laid on the blossoms.

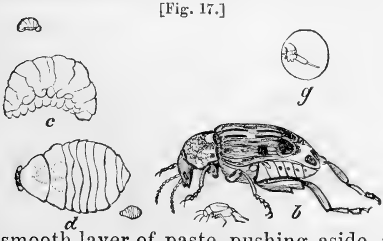
The true natural history of the Pea-weevil may be thus briefiy told. The beetles begin to appear as soon as our peas are in bloom, and when the young pods form, the female beetles gather upon them and deposit their eggs on any part whatever of the surface without attempting to insert the eggs within the pod.

The eggs, (Fig. 16,) are deep yellow, 0.035 inch long, three times as long as wide, fusiform, pointed in front, blunt behind, but larger anteriorly than posteriorly. They are fastened to the pod by some viscid fluid which dries white and glistens like silk. As the operation of depositing is only occasionally noticed during cloudy weather, we may safely assume that it takes place for the most part by night. If pea vines are carefully examined in this latitude any time during the month of June, the pods will often be found to have from one to fifteen or twenty such eggs upon them, and the black head of the future larva may frequently be noticed through the delicate shell.

[Fig. 16.]

As already stated, the eggs are deposited on all parts of the pod, and the mother beetle displays no particular sagacity in the number which she consigns to each, for I have often counted twice as many eggs as there were young peas, and the larvæ from some of these eggs would of course have to perish, as only one can be fully developed in each pea. The newly hatched larva is of a deep yellow color with a black head, and it makes a direct cut through the pod into the nearest pea, the hole soon filling up in the pod, and leaving but a mere speck, not so large as a pin-hole, in the pea. The larva feeds and grows apace and generally avoids the germ of the future sprout, perhaps because it is distasteful, so that most of the buggy peas will germinate as readily as those that have been untouched. When full grown this larva presents the appearance of Figure 17, *c*, (after Curtis) and with wonderful precognition of its future wants, eats a circular hole on one side of the pea, and leaves only the thin hull as a covering. It then retires and lines its cell with a thin and smooth layer of paste, pushing aside and entirely excluding all excrement, and in this cell it assumes the pupa state (Fig. 17, *d*, after Curtis,) and eventually becomes a beetle, which, when ready to issue,

[Fig. 17.]



has only to eat its way through the thin piece of the hull which the larva had left covering the hole. It has been proved that the beetle would die if it had not during its larval life prepared this passage way, for Ernest Menault asserts* that the beetle dies when the hole is pasted over with a piece of paper even thinner than the hull itself.

REMEDIES AND PREVENTIVES.

Sometimes, and especially when the summer has been hot and prolonged, many of the beetles will issue from the peas in the fall of the same year that they were born, but as a more general rule they remain in the peas during the winter and do not issue till new vines are growing. Thus many yet remain in the seed peas until they are planted and especially is this apt to be the case with such as are planted early. We see, therefore, how easily this insect may be introduced into districts previously free from it by the careless planting of buggy peas, for it has been demonstrated that the beetle issues as readily from peas planted in the earth as it does from those stored away in the bin. All peas intended for seed should be examined and it can very soon be determined whether or not they are infested. The thin covering over the hole of the peas that contain weevils, and which may be called the eye-spot, is generally somewhat discolored, and by this eye-spot those peas which ought not to be planted can soon be distinguished. Where this covering is off and the pea presents the appearance of Figure 15, *b*, there is little danger, for in that case the weevil has either left, or, if still within the pea, is usually dead. It would of course be tedious to carefully examine a large lot of peas, one by one, in order to separate those that are buggy, and the most expeditious way of separating the sound from the unsound, is to throw them into water, when the sound ones will mostly sink and the unsound swim.

There are, however, other and more certain means of preventing the injuries of this insect, and whenever agriculture shall have progressed to that point where by proper and thorough organization all the farmers of a county or of a district can, by vote, mutually agree to carry out a measure with determination and in unison, then this insect can soon be exterminated; for it is easy to perceive that such a result would be accomplished by combinedly ceasing to cultivate any peas at all for one single year! Until some such united action can be brought about, we shall never become entirely exempt from this insect's depredations, for no matter how sound the peas may be that I plant, my vines are sure to be more or less visited by the beetles as long as I have slovenly neighbors. Yet comparatively, my peas will always be enough better to well pay for the trouble, even under these circumstances.

**Insectes Nuisibles a l'Agriculture.*

As already hinted the Pea-weevil prefers a warm to a cold climate, and its devastations are scarcely known in high latitudes. On this account the impression prevails that it does not occur in certain parts of Canada, and few persons are aware that it is nearly as bad, especially in Ontario, as it is with us. We are in the habit of sending to Canada for our seed peas, because we get them free from bugs; but the reason that their seedsmen have such a reputation is to be traced to their greater care in destroying the weevil and in sorting their seed rather than to any immunity from its ravages which their peas possess The following extract from a letter from Mr. Wm. Saunders, of London, Ontario, who, as secretary of the Ontario Fruit Growers' Association and as a prominent member of the Canadian Entomological Society, is as well posted, perhaps, as any one in the Dominion, will give some idea of its occurrence there:

The Pea-weevil I find prevails in all parts of Canada to a greater or lesser extent, from the Red River settlement to Quebec. In some places it is so numerous as to discourage farmers from attempting to grow peas at all, while other localities are but little troubled. About the neighborhood of Windsor (opposite Detroit) there are no peas grown worth speaking of; but 60 or 70 miles further east, towards London, they are an important crop, and about London, say within 30 or 4 miles, and as far east as Guelph and Hamilton, will include the chief district from which your western supplies are drawn.

During 1869 I grew a field of peas on my own farm. They produced a good crop, and although we have some of them on hand yet I have never observed a buggy one amongst them, although I have examined them several times. But it is rare to find them so free as that and something depends on the season. Last season the weather was very wet and the crop very light, and the dealers tell me now that there are scarcely any peas fit to ship in the country on account of the quantity of bugs they contain. They say that they always have to select for shipping, and while sending them as clean as possible they do not profess to send them entirely free from bugs.

Our farmers here are perhaps a little more particular than yours about their seed. They will sometimes keep it over till the second year or else scald it before planting so as to destroy a large proportion of the bugs. The general opinion seems to be that if peas are sown late, say about the first of June, they will be almost free from bugs in any season, and some adopt this method, but it is not by any means a general thing, for should the weather set in very hot, as it sometimes does about that time, they would become somewhat dwarfed and the crop lessened. I have not heard of any one growing two crops in one season.

Many eminent seedsmen—Mr. Langdon for instance as I have been credibly informed—effectually kill the weevils by enclosing the peas in tight vessels along with camphor. The same object is attained by keeping peas two years, and taking care that the beetles do not escape before they die. Peas will grow well when kept for two years or even longer, but they should always be well dried so as not to mould. A good plan is to tie them up in bags and hang them in an airy place from the time they are gathered till about Christmas, and then in order that they may not become too dry, to put them into

tighter vessels. To a certain extent sound peas may be obtained by planting late, for the period of egg-depositing is limited to about a month. Peas, as Mr. F. A. Nitchy of Jefferson City has demonstrated, may be planted in the central part of the State as late as the first of June, and by the time the plants from such late planted seed begin to bear pods, all the weevils will have died and disappeared. Wherever a second crop of peas can be grown the same year, this second crop will be entirely free from weevils, and though there seems to be some difficulty in producing a second crop in our State, on account of mildew, it is often done in higher latitudes. Choice lots of seed, if found to be infested when received from the seedsman, may be thrown into hot water for a minute or two, and the sprouting of the peas will be quickened, and most of the weevils, but not all, be killed. But whatever plan be adopted to obtain sound seed, it should be every man's aim, in duty to himself and to his neighbors, to plant none but bugless peas!

As natural checks, the Crow Black-bird is said to devour great numbers of the beetles in the spring, and according to Harris the Baltimore Oriole splits open the pods to get at the grubs contained in them.

THE GRAIN BRUCHUS—*Bruchus granarius*, Linn.

[Fig. 18.]

There is a weevil in Europe which is very common, attacking peas there as badly as our own Pea-weevil does in this country. It also infests beans and several other grains and seeds. It has on several occasions been imported with foreign seeds into this country, but very fortunately does not seem so far to have obtained a strong foothold. There is nothing to prevent its doing so, however, except the utmost vigilance on the part of those who import seeds, and it may at any time get scattered over the country by the distribution of infested seed from the Department of Agriculture, unless the authorities are ever watchful to prevent such a catastrophe. To enable a ready recognition of this weevil, I present an enlarged portrait of it at Figure 18. As will be noticed by that figure it bears a tolerably close resemblance to our own Pea-weevil, but it may always be distinguished from the latter species by the following characters as given by Curtis:—

It is in the first place a smaller insect, averaging but 0.14 inch while *pisi* averages nearly 0.20 inch. It is rather darker, there are two small white spots on the disk of the thorax, and the tooth at each side of the thorax is indistinct; the suture of the wing-covers forms a brown stripe, and the apical joint of the abdomen which protrudes

beyond the wing-covers and which is otherwise known as the pygidium, is densely clothed with grayish pubescence, and shows in certain lights four minute dark dots, but no indication of the two large oval spots so characteristic of our Pea-weevil. The four basal joints of the antennæ and the front legs are reddish, and the inner spine of the hind shanks is prolonged.

It would be a sad misfortune to have this insect added to our list of injurious species, and it is no wonder that upon discovering specimens of our own Pea-weevil just disclosed in a parcel of peas which he had taken with him from America, the Swedish traveler Kalm was thrown into such a trepidation lest he should be the instrument of introducing so fatal an evil into his beloved country.

To give some idea of the habits of the Grain Bruchus, I quote the following account from Curtis's Farm Insects:—

"This species, which is everywhere abundant as early as February on the furze when it is in blossom, inhabiting also the flowers of various other plants in the beetle state, as the Rhubarb, Meadow-sweet (*Spiræa ulmaria*), etc., is a most destructive insect in our pea and bean fields, the larvæ feeding in the seeds and sometimes destroying more than half the crop. They are exceedingly abundant in some parts of Kent, where they often swarm at the end of May, and are occasionally found as late as August; indeed I killed one in November, imported with Russian beans, which had been alive since the end of September. It attempted to fly away in October; it then became torpid, but on warming it by a fire in the middle of November, it was as lively and active as in the height of summer, and I dare say would have lived through the winter.

"It is said that the female beetles select the finest peas to deposit their eggs in, and sometimes they infest crops to such an extent that they are eaten up by them, little more than the husk being left. The various kinds of beans are equally subject to their inroads; besides the long-pods I have alluded to, I have had broad Windsor beans sent to me containing these *Bruchi;* and Mr. C. Parsons transmitted me some horse-beans in the beginning of August, 1842, which were entirely destroyed by them. Mr. F. J. Graham showed me some seed beans which were inoculated by these beetles to a great extent, and some of them were alive in the seeds; yet to any one ignorant of the economy of this pest, there would not appear the slightest external indication of their operations. I also received from a gentleman residing in Norfolk a sample of seed beans from Russia, for winter sowing, a large proportion of which was perforated by this *Bruchus.*

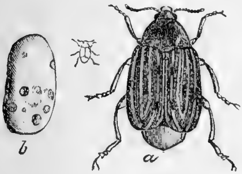
"It has already been intimated that as the beetles generally leave the germ uninjured, the vitality of infested seeds is not destroyed. I doubt, however, if they produce strong healthy plants; and from my own experience I have no doubt if peas and beans be sown containing the *Bruchus granarius*, that the beetles will hatch in the ground, and thus the cultivator will entail upon himself a succession of diseased pea and bean crops. Now to avoid this loss, the seed should be examined before sowing, when to an experienced eye the presence of these beetles will be discernible, where to a common observer they would appear sound and good. The maggots, when arrived at their full size, gnaw a circular hole to the husk or skin of the seed, whether pea or bean, and even cut around the inner surface which covers the aperture, so that a slight pressure from within will force this lid off;

these spots are of a different color to the rest of the seed, generally having a less opaque appearance, and often are of a duller tint; on picking off this little lid, a cavity will be found beneath containing either a maggot, pupa, or beetle."

THE AMERICAN BEAN-WEEVIL—*Bruchus fabæ*, N. sp.

This is another *Bruchus* which bids fair to out-do the celebrated Pea-weevil in its injurious work, and since it has but just made its appearance in our State as a bean destroyer, and is yet confined, so far as I am aware, to one single locality, I hope that the following account of it will have the effect to prevent its introduction into neighborhoods where it is now unknown, and thus keep it from spreading over the State. It appears to be a native American insect and doubtless fed originally on some kind of wild bean (*Phaseolus* or *Lathyrus*,) but it was first noticed in our cultivated beans about ten years ago, in Rhode Island, and has since at different times suddenly made its appearance in several other parts of the country. Maj. J. R. Muhleman, of Woodburn, Ills., informs me that while in South Carolina in 1863, some kind of weevil was often so common in the beans used by the army that before using such beans the men had to soak them, and afterwards lay them out to dry, in order to allow the beetles to escape. The weevil was doubtless the species under consideration, but there is no means of ascertaining from which part of the country the beans came.

[Fig. 19.]



Though already pretty well distributed in some of the Eastern States, especially in New York, it appears to be yet confined to certain localities in the Mississippi Valley. It has for instance, been quite troublesome of late years in Madison county, Ills., for I received last spring numerous specimens from Mr. Geo. W. Copley, of Alton, and am informed by Mr. J. F. Wielandy, of Jefferson City, Mo., that his father who is a resident of that county has been much troubled with it; yet it has never been heard of in other parts of the State. The only place in which I have, so far, found it in Missouri, is around Eureka, in St. Louis county, where it was first noticed in 1869, but where it occurred the present year in great numbers in two different fields of a white pole bean. It occurs in some parts of Pennsylvania, and is quite common in New York, and to illustrate the amount of damage it is capable of doing, I make room for the following letter, which was received in November, 1870, from Mr. James Angus, of West Farms, N. Y., and which refers to this insect:

I enclose you a sample of beans to show you how thoroughly and effectually this little vagabond is plying his time immemorial avocations in the bean-patches in this quarter. Five or six years ago I had occasion to call on a neighbor, and in passing through the barn he

pointed out to me a heap of threshed beans, on the floor, of the Early Mohawk variety, which he said had been destroyed by bugs getting into them since they were threshed. (?) A casual inspection showed that they were destroyed sure enough. At least one-half of them were as badly infested as the sample I send you, but as I pointed out to him, the damage which was now an accomplished fact, had been commenced during the growing season, and the "bugs" were now leaving the beans instead of entering them.

Next season I found a few among my own beans, and they have been on the increase ever since; and this year my Yellow Six Week variety are nearly as bad as my neighbors referred to above. They are nearly as bad this year on a pole variety, the "Dutch Case Knife," as they are on the low growing ones. The small black bush variety, however seems to have escaped them. If some check is not put to their ravages soon, the culture of beans will have to be given up here.

In a short article on this weevil, published by Mr. S. S. Rathvon, in the *American Entomologist*, (Vol. II, pages 118-119,) that gentleman gives the following account of its appearance in his neighborhood:

My specimens evolved in the months of June, July, August and September, from three varieties of the domestic bean (*Phaseolus*,) commonly called "Cranberry," the "Agricultural," and the "Wrens-egg" beans, obtained from Mrs. P. C. Gibbons, Enterprise, Lancaster county, Pa. * * * * I have not yet heard of this insect being found in any other locality in Lancaster county than the one above named. The tenant from whom Mrs. Gibbons received these infested beans has been engaged in the bean culture for twenty-five years on the same farm, and never noticed these weevils until within the last two or three years, and only last year did their destructive character become conspicuously apparent; for out of a small sack of seed-beans hung away, containing less than two quarts, she gathered nearly a teacup-full of the weevils at planting time, in the early part of June, and had all been infested as those were which she brought to me, she could have easily doubled the quantity. About five years ago Mrs. Gibbons received some seed-beans of the "Cranberry" variety, from Nantucket, Mass., and prior to that, she also received some from the Agricultural Department of the Patent Office, and with the one or the other of these, the impression is that the weevils must have been received.

If, as I have supposed (and by perusing what is printed below in small type, the reader will see that no other conclusion can be drawn), this weevil is indigenous; it may possibly occur over large tracts of our country, though the fact that, till a few years ago, it had never been collected by any American entomologist, would strongly intimate that, in what may be termed its wild state, it was quite rare and had a limited range. But even if it should occur in this wild state more generally through the country than the facts would lead us to believe, there is nevertheless more danger of its being introduced into a bean field hitherto exempt by the planting of infested cultivated beans, than by its spreading from the wild food. And if once a few buggy beans are planted, they will in a few years contaminate the other beans cultivated in the neighborhood, so that the man who year after

year grows his own seed will suffer as much as the man who originally introduces the weevils from afar.

Except in being smaller, the larva and pupa of this weevil have a close resemblance to those of the Pea-weevil, and its habits are very similar, with the exception that the female deposits a greater number of eggs on a single pod, so that sometimes over a dozen larvæ enter a single bean. I have counted as many as fourteen in one small bean, and the space required for each individual to develop is not much more than sufficient to snugly contain the beetle. The little spot where the Pea-weevil entered can always be detected even in the dry pea, but in the bean these points of entrance become almost entirely obliterated. The cell in which the transformations take place is more perfect and smooth, and the lining is easily distinguished from the meat of the bean by its being more white and opaque. The excrement is yellow or darker than the meat, and even where a bean is so badly infested that the inside is entirely reduced to this excrementitious powder, each larva, before transforming, manages to form for itself a complete cell, which separates it from the rest of its brethren. The eye-spot, as in the pea, is perfectly circular and quite transparent in white-skinned varieties, so that infested beans of this kind are easily distinguished by the bluish-black spots which they exhibit (Fig. 19, *b*). Dark beans when infested are not so easily distinguished.

I have always found the germ either untouched or but partially devoured even in the worst infested beans, so that when but two or three weevils inhabit a bean, it would doubtless grow; but where the meat is entirely destroyed, as it often is, the bean would hardly grow though the germ remained intact, and it would certainly not produce a vigorous plant.

Many of the beetles are perfected in the fall, but many of them not till the following spring, so that there is the same danger of introducing them in seed-beans, as in the case of the Pea-weevil. The remedies and preventives given in the former case will of course apply equally well in this, and I hope that every bean-grower in Missouri who reads this article will make some effort to keep the scourge out of his own neighborhood, by urging upon others, at the Farmers' Club, or at the meetings of any local societies, the necessity of sowing only sound seed, and of thoroughly destroying any that may be received from abroad and found buggy.

Regarding the proper nomenclature of our Bean-weevil, there has been some confusion, and though it has heretofore been considered by several eminent entomologists as the *Bruchus obsoletus* of Say, and I have heretofore, upon insufficient grounds, referred it to that species myself, it nevertheless turns out to be undescribed. In Europe, besides the Grain Bruchus which I just treated of, there are several other species belonging to the same genus which attack

beans; but our insect differs from all of them and especially from the Grain Bruchus, to which it has been erroneously referred by Dr. A. S. Packard, Jr.* If it were the imported Grain Bruchus, our peas and some other grains would probably suffer as much from its attacks as our beans, because that species infests peas and other seeds in Europe; but in reality we have no more reason to believe that our Bean-weevil will attack our peas than that the Pea-weevil will attack our beans.

The general color of our Bean-weevil is tawny-gray, the ground-color being dark and the whole body covered with a grayish pubescence which inclines to yellow or fulvous, or wears a slight moss-green hue, and is shaded as in Figure 19, *a*. It is but half the size of the Pea-weevil and has the four or five basal joints and the terminal joint of the antennæ, and the legs, with the exception of the lower and inner part of the hind thighs, reddish-brown.

BRUCHUS FABÆ N. Sp. (Fig. 19,)—General color tawny-gray with more or less dull yellowish. *Body* black tinged with brown and with dull yellowish pubescence, the pygidium and sides of abdomen almost always brownish. *Head* dull yellowish-gray with the jaws dark brown and palpi black; antennæ not deeply serrate in ♀, more so in ♂; dark brown or black with usually 5, sometimes only 4, sometimes 4 and part of 5 basal joints, and with the terminal joint, more or less distinctly rufous, or testaceous, the color being so slight in some specimens as scarcely to contrast at all with the darker joints. *Thorax* narrowed before, immaculate, but with the pubescence almost always exhibiting a single pale medio-dorsal line, sometimes three dorsal lines, more rarely a transverse line in addition, and still more rarely (two specimens) forming a large dark, almost black patch each side, leaving a median stripe and the extreme borders pale and thus approaching closely to *erythrocerus* Dej.; base with the edges almost angulated; central lobe almost truncate and with a short longitudinal deeply impressed median line; no lateral notch; scutel concolorous and quadrate with the hind edge more or less notched. *Elytra* with the interstitial lines having a slight appearance of alternating transversely with dull yellowish and dusky; so slight however that in most of the specimens it can hardly be traced: the dark shadings form a spot on each shoulder and three transverse bands tolerably distinct in some, almost obsolete in others, the intermediate row being the most persistent and conspicuous: between these dark transverse rows the interstices are alternately more or less pale, especially on the middle of the 3rd interstitial lines. *Legs* covered with grayish pubescence, and with the tibiæ and tarsi, especially of first and second pair, reddish-brown; the hind thighs usually somewhat darker, becoming black below and inside, and with a tolerably long black spine followed by two very minute ones. Length 0.09—0.14 inch. Described from 40 specimens all bred from different kinds of beans. Hundreds of others examined.

This insect has been for several years ticketed in some of the Eastern collections by the name of *B. fabæ*, or else, what is worse, the corruption of it, *fabi*. The former name has been disseminated by my friend F. G. Sanborn of Boston, Massachusetts, who says that he received the weevil thus named, together with beans attacked by it, in the year 1862 from Rhode Island. The name was credited to Fabricius, but I can find no notice in any of the works I possess of any European *Bruchus fabæ*, and several of my Eastern correspondents who have access to large libraries have been unable to find any description or allusion to a species by that name. Dr LeConte has given it the MS name of *varicornis* but as his description will not appear perhaps for years to come and as no comprehensive description has yet been published, I have deemed it advisable to dispel in a measure the confusion that surrounds the nomenclature of the species. There is need of a description of so injurious an insect, and as *fabæ* is not preoccupied I adopt the name because it is entirely appropriate and because it is more easily rendered into terse popular language that *varicornis*. †

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* Injurious insects new and little known, pp. 19–21.

† No one can have a greater regard than I have, for the work of our great Coleopterist, Dr. LeConte, who is justly looked up to as our authority in his specialty; and for no other reason than the one given above would I venture to disregard even one of his manuscript names. Were he now at home, I should have corresponded with him on the subject, and I feel satisfied that he would have sanctioned this course. These remarks are prompted by the fact that certain entomolo-

It resembles most closely of any other species which I have seen, the *B. erythrocerus*, Dej.: which, however, is smaller, and differs in having a narrower thorax which has light sides and a dark, broad dorsal stripe divided down the middle by a pale narrow line: *erythrocerus* is further distinguished by the antennæ being entirely testaceous and the hind thighs more swollen.

From *obsoletus* Say, *fabæ* differs materially: *obsoletus* is a smaller species, dark gray, with the antennæ all dark, the pygidium not rufous, the thorax with a perceptibly darker dorsal shade so that the sides appear more cinereous, a white scutel, and each interstitial line of the elytra with a slight appearance of alternating whitish and dusky along its whole length; for though there is nothing in Say's language to indicate whether it is the interstitial lines that alternate transversely, whitish and dusky, or each line that so alternates longitudinally, I find from an examination of a specimen in the Walsh collection, that the latter is the case, and so much so that the insect almost appears speckled. The two species differ both in size and color, though, as Say's description is short and imperfect it is not surprising that *fabæ* should have been referred to it.

From the European bean-feeding *Br. flavimanus* (which is apparently either a clerical error for, or a synonym of *Br. rufimanus*, Schœnh.) as described by Curtis, it differs notably; as it does likewise from their *Br. serratus*, Ill., which also attacks beans.

Dr. LeConte, according to Mr. Rathvon, was inclined to consider this insect the *obsoletus* of Say, from the fact that in specimens which the latter gentleman sent him, the antennæ were not varied as in his MS. *varicornis*, but uniformly black. A few specimens which Mr. Rathvon sent me nearly two years ago, taken from the same lot as were those which he forwarded to Dr. LeConte, were singularly enough, all decapitated but two; and these two showed the varied antennæ. These specimens had all been kept in alcohol, and I am greatly inclined to believe that the uniformly dark appearance of the antennæ that was noticed by LeConte was the effect of the alcohol on those which naturally had the rufous joints but faintly indicated. At all events, though Mr. Rathvon tells me that he found a small proportion of beetles with dark antennæ, after examining, at my suggestion, over two hundred specimens that had thus been kept in alcohol; yet from over one hundred specimens which he had the kindness to send me, I only find (after thoroughly drying them) three with the terminal joint really as dark as the subterminal, and not a single one in which the rufous basal joints cannot be more or less distinctly traced.

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gists have objected to isolated descriptions of insects, on the plea that they cause confusion and an unnecessary synonymy in our nomenclature. There is, in fact, a certain class of persons—and they have been aptly termed closet-entomologists—who manifest a superlative contempt for anything that does not appear in the transactions or publications of some scientific society; and they even claim that the descriptions which have appeared in State Entomological Reports are invalid and should be disregarded. The descriptions of Dr. Fitch, and many of those of the late Mr. Walsh, and my own, would of course come under this head. It is a little significant, however, that the very persons who manifest such a contempt for scientific work, whenever it is combined with the practically useful, are the very ones who indulge in the fatal monomania for grinding out new species from the mere comparison of a few more or less damaged specimens of the perfect insects, obtained nobody knows how, when or where; and without even the slightest knowledge of the larval and pupal history and the general habits of the so-called species. They make species out of the slightest individual variation, and even erect genera upon a slight individual difference in the size or shape of the wing. So baseless a system must necessarily be fraught with great scientific untruthfulness, and is well calculated to disgust the student who endeavors to rightly interpret the significances in Nature. An immense number of the published descriptions in the Class of insects in this country are based upon the simple examination of solitary specimens of the perfect insects, without the fact being mentioned, and are therefore not in any true sense of the term descriptions of species, but mere descriptions of individuals. The few men whose sole ambition seems to be to attach their names to as many of these so-called species as possible, are the ones who are most inclined to sneer at, and treat lightly the honest work of more practical men—forgetting that science does not consist of mere classification and orderly arrangement, but that she wears a nobler mien when applied to penetrating and comprehensive search after Nature's truths.

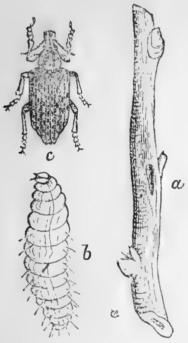
A truth is equally scientific, whether published in a plain, practical work, or in the drier pages of the transactions of some august scientific body; and so far as the science of entomology is concerned, it will certainly be more advanced by the full and comprehensive description of a species, albeit such description be clothed in plain terms and published in a popular work, than by a less complete and more confused description, in the transactions of an Entomological Society; and provided it is published in a work essentially entomological, the monographer will certainly prefer the former to the latter. In the past, science belonged to the few, and was always paraded before the world in as unattractive and technical a form as possible. To-day she is fast becoming the property of the multitude, and should be popularized as much as possible; for it is folly to suppose, as some men do, that in science "popular" and "inaccurate" are synonymous terms, simply because some writers have failed to combine the scientifically accurate with the popular and practical.

The entomologist who occupies himself with the habits of insects, cannot well become a systematist, and would far sooner accurately describe the hitherto unknown habits and transformations of a single common species, than describe a dozen new ones. He may have hundreds of new species in his cabinet; but these he prefers to turn over to the specialist, whose work he fully appreciates and whose aid he must often seek. When, however, in the course of his work, he is obliged to publish an isolated description, the specialist proper should certainly not depreciate his labor, providing it is well performed.

THE NEW YORK WEEVIL—*Ithycerus noveboracensis*, Forster.

The large gray beetle represented at *c*, in the accompanying cut often does considerable damage to fruit trees, and I con-

[Fig. 20.]



tinually receive it every spring by persons who desire to know more of its habits. It kills the twig by gnawing off the tender bark, in the early part of the season before the buds have put out, and later in the year it destroys the tender shoots which start out from old wood, by entirely devouring them. It eats out the buds and will also frequently gnaw off the leaves at the base of the stem, after they have expanded. It attacks, by preference, the tender growth of the Apple, though it will also make free with that of Peach, Plum, Pear and Cherry, and probably of other fruit as well as forest trees. It is the largest snout-beetle which occurs in our State. and with the rest of the species belonging to the same genus (*Ithycerus*=straight-horn) it is distinguished from most of the other snout-beetles by the antennæ or feelers being straight instead of elbowed or flail-shaped as they are in the common Plum Curculio, for instance. The specific name *noveboracensis* which means "of New York" was given to this beetle just 100 years ago by Forster, doubtless because he received his specimens from New York. But like many other insects which have been honored with the name of some Eastern State, it is far more common in the Mississippi Valley than it is in the the State of New York, it scarcely being known as an injurious insect in the East. It was subsequently described as *Pahyrhynchus Schœnherri* by Mr. Kirby. The general color of the beetle is ash-gray, marked with black as in the cut (Fig. 20, *c*), and with the scutel or small semi-circular space immediately behind the thorax, between the wings, of a yellowish color. Its larval habits were for a long time unknown, but two years ago I ascertained that it breeds in the twigs and tender branches of the Bur oak, and have good reason to believe that it also breeds in those of the Pignut hickory. The female in depositing, first makes a longitudinal excavation with her jaws (Fig. 20, *a*) eating upwards under the bark towards the end of the branch, and afterwards turns round to thrust her egg in the excavation. The larva, (Fig. 20, *b*) hatching from the egg is of the usual pale yellow color with a tawny head. I have watched the whole operation of depositing, and, returning to the punctured twig a few days after the operation was performed, have cut out the young larva; but I do not know how long a time the larva needs to come to its growth, nor whether it undergoes its transformations within the branch, or leaves it for this purpose to enter the ground; though the former hypothesis is the more likely.

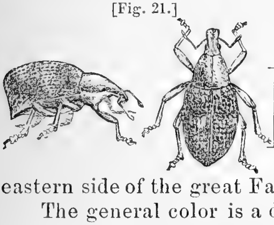
This insect is more active at night than during the day, and is often jarred down upon the sheet or the Curculio-catcher, for it falls about as readily as the Plum Curculio.

The destructive pear blight, otherwise known as fire-blight, has been attributed to a peculiar poisonous fluid which this beetle secretes and with which it poisons the wood.* I have never noticed any such secretion, and feel quite convinced that it has nothing to do with the real pear blight (and there are more than one kind) which is very justly considered by the most eminent horticulturists of the land to be of fungoid rather than insect origin. It is quite probable that the beetle secretes some such fluid which causes a sort of blight, because several bark-boring and wood-boring beetles are known to produce such an effect; but this insect-blight must not be confounded with the far more subtle and destructive Pear Blight, so called.

THE IMBRICATED SNOUT-BEETLE—*Epicærus imbricatus*, Say.

This is another insect, which is quite frequently met with on our different fruit trees, doing considerable injury to apple and cherry trees and gooseberry bushes, by gnawing the twigs and fruit. Its natural history is, however, a sealed book, and I introduce it at present more to draw the attention of orchardists to this fact than to give any information with regard to it. The beetle is a native of the more Western States and is found much more commonly in the western part of the State, in Iowa, Kansas, and towards the mountains than it is on the eastern side of the great Father of Waters.

[Fig. 21.]



The general color is a dull silvery-white with brown markings as in the figure (Fig. 21), which are sometimes dark and distinct, and at others almost obsolete. Indeed the species is so variable that it has received no less than four distinct names, *i. e.* four distinct species have been fabricated out of one.†

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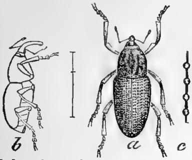
*See a communication from H. H. Babcock, of Chicago, in the *Am. Entomologist and Botanist*, Vol. II, p. 176.

†There can be no doubt of this, for the range of variation is so great that specimens agreeing in every respect with *imbricatus*, *fornudolosus*, *vadosus* and *fallax*, are to be met with in very limited localities; and both Dr. LeConte and Mr. Walsh were of opinion that these four so-called species were but varieties.

THE CORN SPHENOPHORUS—*Sphenophorus zeæ*, Walsh.

In the last number of the *Practical Entomologist*, Mr. Walsh gave the first account of a weevil which in certain years does great damage to the corn crop by puncturing the young plant near the ground, and riddling it with holes of about the size that an ordinary pin would make. They may even be found under ground attached firmly to the stalk, and when numerous enough the plant always dies.

[Fig. 22.]



The color of the beetle is brown-black or black, often obscured by yellowish or grayish matter adhering to, and filling up the hollow punctures. Figure 22 gives a good illustration of it, *a* showing a shaded back view, *b* an outline side view, and *c* showing the manner in which the wing-covers are punctured. The original description as given by Mr. Walsh will be found below.

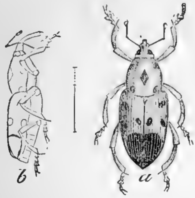
In the spring of 1868, Mr. L. V. Smith, of Geneva, Ontario county, N. Y., sent me numerous specimens; and I have often found it in great numbers on the lake-beach at Chicago, though it does not seem to be common in our own State. But it is well that corn-growers be made familiar with its appearance.

The larval history of this weevil is unknown, but there seems good reason to believe that it breeds in rotting and moist wood, situated in places where it is constantly washed by the water; for the beetles, with others belonging to the same genus are found in such situations and in decayed logs floating in swamps. If this supposition be the correct one—and the fact that it has been injurious only in the immediate neighborhood of rivers and lakes adds great weight to such a supposition—then this weevil will not be likely to multiply unduly where there are not large bodies of water.

"SPENOPHORUS ZEÆ, new species? Color black, often obscured by yellowish matter adhering to the hollow places, which, however, can be partially washed off. Head finely punctured towards the base, with a large dilated puncture between the eyes above. Snout one-third as long as the body, of uniform diameter, as fine as a stout horse-hair, and curved downwards. Before the middle of the thorax a polished diamond-shaped space, prolonged in a short line in front and in a long line behind; and on each side of this an irregularly defined polished space, somewhat in the form of an inverted Y; the rest of thorax occupied by very large punctures, which fade into finer and sparser ones on the polished spaces. Wing-cases with rows of still larger punctures, placed very wide apart in the usual grooves or striæ; the sutural interstice, that between the 2nd and 3rd striæ, and that between the 4th and 5th striæ wider than the rest, elevated, and occupied by very fine punctures; a small elongate-oval polished spot on the shoulder and another near the tip of the wing-case. Beneath, polished, and with punctures as large as those of the thorax.—Length about three-tenths of an inch, exclusive of the snout. Comes very near *Sphenophorus truncatus* Say, but the snout is not "attenuated at tip" and has no "elongated groove at base above;" and moreover, nothing is said in the description of that species of the very large and conspicuous punctures, found in the elytral striæ of our species."

THE COCKLEBUR SPHENOPHORUS—*Sphenophorus pulchellus*, Schœnherr.

[Fig. 23.]



In closing this chapter on snout-beetles I introduce this species (Fig. 23, *a* shaded back view; *b* outline side-view,) not that it is injurious, but because it belongs to the same genus, and is closely allied to the preceding insect; and because its larval habits, which are now given for the first time, may lead us more readily to discover those of its more injurious ally.

The color of this beetle above, is of a deep brick-red inclining to blood-red, often with a tinge of orange, and it is marked with black as in the figure, the whole underside being also black. The larva bores the stalks of the common cocklebur (*Xanthium strumarium*,) and differs from most other snout-beetle larva in having a dark mahogony-brown head, and in the anal joint being slantingly truncated and furnished with fuscous elevations which give rise to short stiff bristles. It transforms in the fall of the year within the stem and issues as a beetle about the end of September.*

Of our other N. A. snout-beetles may be mentioned as especially injurious the Grape Curculio (*Cœliodes inæqualis*, Say), Grape-cane Curculio (*Baridius sesostris*, Lec.) Potato-stalk weevil (*Baridius trinotatus*, Say), the different nut-weevils (genus *Balaninus*), the Grain-weevil (*Sitophilus granarius*, Linn.), the White-pine weevil (*Pissodes strobi*, Peck), and the Cranberry-weevil (*Anthonomus suturalis*, Lec.) The first three have already been treated of in my first Report, the nut-weevils will form the subject of a future article, and the others have either been fully treated of in standard works or are not particularly injurious in Missouri.

*This insect seems to differ from 13-*punctatus*, Say, in absolutely nothing but in having a large black patch at the tip of the elytra instead of two spots. I have bred four specimens from cocklebur, and they are all tolerably constant in the characters accorded to *pulchellus*. But I am strongly of opinion that we have to deal here with but one species, and that with a sufficiently large series, the dividing line could not be drawn. At all events 13-*punctatus* is very variable in the size of its spots, and the greatest variation occurs in these two at the tip of the elytra, while Say describes and figures a variety of his 13-*punctatus* which is singularly intermediate between the two species. In three specimens of 13-*punctatus* in my cabinet, the two posterior spots are so large that they almost meet, while in some specimens they are not larger than the other elytral spots.

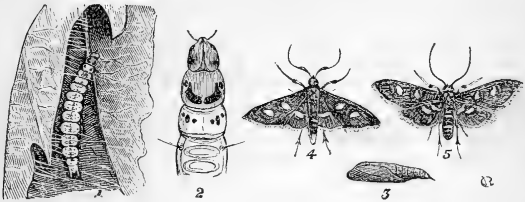
INSECTS INJURIOUS TO THE GRAPE-VINE.

The following articles under this head are a continuation of the series began in my first and continued in my second Report, and I shall continue the series until all the insects of any note, which affect the Grape-vine, shall be treated of.

THE GRAPE LEAF-FOLDER—*Desmia maculalis*, Westw.

(Lepidoptera, Asopidæ.)

[Fig. 24.]



The subject of this sketch has long been known to depredate on the leaves of the Grape-vine in many widely separated parts of North America. It is not uncommon in Canada West, and is found in the extreme southern parts of Georgia. It appears to be far more injurious, however, in the intermediate country, or between latitude 35° and 40°, than in any other sections, and in Southern Illinois and Central Missouri proves more or less injurious every year. It was first described and named by Westwood,* who erected, for it, the genus *Desmia*.

The genus is characterized by the elbowed or knotted appearance of the ♂ antennæ, in contrast with the smooth, thread-like ♀ antennæ; the maxillary palpi are not visible, while the compressed and feathery labial palpi are recurved against the eyes, and reach almost to their summit; the body extends beyond the hind wings.

The moth of the Grape Leaf-folder is a very pretty little thing, expanding on an average almost an inch, with a length of body of about one-third of an inch. It is conspicuously marked, and the sexes differ sufficiently to have given rise to two names, the female having been named *Botys bicolor*. The color is black with an opalescent reflection, and the under surface differs only from the upper in being less bright; all the wings are bordered with white. The

* Mag. Zool., par M. Guérin, 1831; pl. 2.

† Mr. Glover, in the Agricultural Report for 1854, p. 79, says that the male has a semi-lunar mark of white on the outside of each spot, which in his figure, pl. 6, ibid., is very distinct. In dozens of specimens bred in Illinois and Missouri no such mark appears, though there is an apparent coincident shade, barely distinguished from the black ground-color, on the outside of each spot in both male and female.

front wings of both sexes are each furnished with two white spots;† but while in the male (Fig. 24, 4) there is but one large spot on the hind wings, in the female (Fig. 24, 5) this spot is invariably more or less constricted in the middle, especially above, and is often entirely divided into two distinct spots. The body of the male has but one distinct transverse band, and a longitudinal white dash at its extremity superiorly, while that of the female has two white bands. The antennæ, as already stated, are still more characteristic, those of the male being elbowed and thickened near the middle, while those of the female are simple and thread-like.

There are two broods in this latitude—and probably three farther south—during the year; the first moths appearing in June, the second in August, and the worms produced from these last hibernating in the chrysalis state. The eggs are scattered in small patches over the vines, and the worms are found of all sizes at the same time. These last change to chrysalids in 24 to 30 days from hatching, and give forth the moths in about a week afterwards.

The worm (Fig. 24, 1) folds rather than rolls the leaf, by fastening two portions together by its silken threads; and for this reason, in contradistinction to the many leaf-rollers, may be popularly known as the "Grape Leaf-folder." It is of a glass-green color,* and very active, wriggling, jumping and jerking either way at every touch. The head and thoracic segments are marked as at Figure 24, 2. If let alone, these worms will soon defoliate a vine, and the best method of destroying them is by crushing suddenly within the leaf, with both hands. To prevent their appearance, however, requires far less trouble. The chrysalis is formed within the fold of the leaf, and by going over the vineyard in October, or any time before the leaves fall, and carefully plucking and destroying all those that are folded and crumpled, the supply for the following year will be cut off. This should be done collectively to be positively effectual, for the utmost vigilance will avail but little if one is surrounded with slovenly neighbors.

I believe this insect shows no preference for any particular kind of grape-vine, having found it on well nigh all the cultivated as well as the wild varieties. Its natural enemies consist of spiders, wasps, and a small undescribed species of *Tachina*-fly which I have ascertained to infest it in the larva state, and to which I have given the MS. name of *desmiæ*. There is every reason to believe that it is also attacked by a small clay-yellow beetle, the Grape-vine Colaspis

* I subjoin a description of this worm, as first given by me in the Prairie Farmer Annual for 1868. Average length, 0.80. Largest on abdominal joints, and tapering thence slightly each way. Color glass-green, always darker above than below. A narrow darker dorsal line, with each joint swollen into two transverse wrinkles. Laterally paler or yellowish, and a large and distinct piliferous spot on each joint, with others scarcely visible with a lens. Head fulvous, polished, horizontal, with two small eyespots and two larger dark patches. Joint 1 of the same color, and marked as in Figure 24, 2. Joint 2 has two small spots, with an intermediate larger one, on each side. Legs yellowish. Acquires a carneous or pink tint before changing to chrysalis, which latter is of the normal color, size and form of Figure 24, 3, and has at the tail several very minute curved hooks, joining and forming into a point.

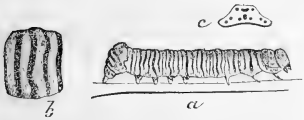
(*Colaspis flavida*, Say,) which is described further on, and which, though a vegetable feeder, may often be found in the fold of the leaf in company with some shrunken, half-dead worm.

THE GRAPE-VINE EPIMENIS.—*Psychomorpha epimenis*, Drury.

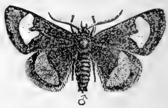
(Lepidoptera Zygænidæ.)

Under the head of "Blue Caterpillars of the Vine," an account was given in my last Report (pp. 83–5) of the Pearl Wood Nymph, (*Eudryas unio*, Huebner), and of what I thought there was good reason to believe was its larva, namely, the smaller of the blue caterpillars (Fig. 25, *a* full grown caterpillar; *b* enlarged side view of one of the joints; *c* enlarged hump on the 11th joint). I have since been able to decide definitely as to the character of this larva, having bred numerous specimens to the perfect state. It turns out to be an entirely different insect to what I had conjectured, and produces a beautiful little moth (Fig. 26), which may be known to the grape-grower as the Grape-vine Epimenis.

[Fig. 25.]



[Fig. 26.]



This moth is most strikingly marked and bears no resemblance whatever to the Pearl Wood Nymph. Its color is deep velvety-black with a broad irregularly lunate white patch across the outer third of the front wings, and a somewhat larger, more regular patch of orange-red or brick-red on the hind wings. The underside is similarly marked, but that of the front wings is less velvety with two additional white spots inside near the costa, the outer one generally, and sometimes both of them, connected with the broad white patch. Especially is this the case in the males; the wing appearing to have a large triangular white patch with two quadrate black spots in it connected with the costa. The wings are beautifully tinselled with steel-blue, or purplish scales, which form a narrow band near the outer margin of each and appear more or less distinctly on the basal half of the front wings. On the under side the steel-blue is especially conspicuous on the costa and hind border of the hind wings. In old specimens the scales get much rubbed off and the general color appears duller and more brown. The antennæ of the female are thread-like and with alternate black and white scales. Those of the male are beautifully and broadly toothed on two sides, or bi-pectinate, and he is furthermore distinguished from the female by the more uniform

diameter of his abdomen which is slightly tufted and squarely cut off at the apex.

A full account was given of the larva in the article already referred to, and the proper remedy for its injuries suggested, so that I shall simply add below a technical description of it. Its habit of boring into some substances to prepare for the change to pupa, is inveterate, and it always neatly covers up the orifice so that it is difficult to detect. I have had over a dozen of them enter a single cork but $1\frac{1}{4}$ inches in diameter and about an inch deep; and such a cork, if given during May of one year to an uninitiated person, with instructions to keep it in a glass vessel, will cause much surprise and interest the following March when the moths will begin to issue from it.

Dr. Melsheimer* wrote to Dr. Harris on the 28th of February, 1840, that he had bred this moth from the larva, and rightly states that recent specimens are not brown, and that the larva is a half looper; but he does not mention its food-plant. Dr. Packard,† who does not mention the sexual differences, quotes Harris as stating on the authority of Abbott, that the larva feeds on the wild Trumpet-creeper (*Bignonia radicans*) in Georgia. But no one has heretofore mentioned its Grape-vine feeding propensities, and it is consequently now added for the first time to our list of Grape-vine depredators, and there are four instead of three bluish caterpillars, all bearing a close general resemblance, which feed upon that plant. They all occur in Missouri, but the present species is far more numerous and destructive than the other three put together. I have now described three of them, and shown wherein they differ from one another, and the fourth, namely, the larva of the Pearl Wood Nymph, is said by Dr. Fitch to so closly resemble that of the Beautiful Wood Nymph that we know not yet whether there are any distinguishing characteristics between them.

PSYCHOMORPHA EPIMENIS, Drury—*Larva.*—General appearance bluish. The ground-color is however pure white, and the apparent bluish cast is entirely owing to the ocular delusion produced by the white with the transverse black bands as in *Alypia octomaculata.* Transversely banded with four black stripes to each joint, the third and fourth being usually rather wider apart than the other two, and diverging at the lower sides where they make room for two more or less conspicuous dark spots placed one below the other; the third on some of the middle joints is frequently broken, with an anterior curve, just above stigmata, and on joints 2 and 3 it is twice as thick as the rest. Cervical shield, hump on joint 11, anal plate, legs and venter, dull pale orange. Joint 1 with about 14 large shiny piliferous black spots, 8 of which form two rows on the cervical shield (those in the anterior row being largest and farthest apart,) and six of which are lateral, namely, three each side, with more or less distinct dusky marks between and in front of them. The spots on the hump are usually placed as at Figure 26, *c*, but vary very much, though the four principal ones on the top are generally placed in a square. The anal plate is marked with 8 such spots, very much as in the cervical shield, but smaller. The tips of the thoracic legs are black and the other legs and venter are also spotted. Head gamboge-yellow, inclining to orange, with 8 principal and other minor black piliferous spots. The ordinary piliferous spots are small, and except two dorsal ones which are in the white space between the second and third band, they are not easily detected. The stigmata are also quite small and round. The abdominal prolegs de-

* Harr. Corr., p. 111.
† Guide, etc., p. 281.

crease in size from the last to the first pair, and the larva curves the thoracic joints and is a half-looper, especially when young. Average length about one inch. Described from numerous specimens.

Chrysalis.—Average length 0.37 inch; reddish-brown; rugose, especially on dorsum of abdominal joints, but distinguished principally by the truncated apex, which has a large horizontally compressed ear-like horny projection at each upper and outer edge.

THE GRAPE-VINE PLUME—*Pterophorus periscelidactylus*, Fitch.

(Lepidoptera, Alucitidæ.)

In my first Report a short account has already been given of this insect, but as it was very numerous last spring, and as I had good opportunities of making further observations, I have concluded, by aid of the accompanying figure, to give a more complete account of it.

[Fig. 27.]

In the earlier published Proceedings of our State Horticultural Society reference is occasionally made to "small grey or green worms which feed on the young leaves before blossoming," * without any definite name being given to them. Husmann, in his "Grapes and Wine," (p. 80) mentions similar worms, and I have little doubt but that the insect referred to is the little Plume we are now considering.

Just about the time that the third bunch of grapes, on a given shoot, is developing, many of the leaves, and especially those at the extremity of the shoot, are found fastened together more or less closely, but generally so as to form a hollow ball. These leaves are fastened by a fine white silk, and upon opening the mass and separating the leaves, one of two caterpillars will generally be found in the retreat. I say one of two, because the retreat made by the smallest of the Blue Caterpillars of the Vine, namely, the larva of the Grape-vine Epimenis (Fig. 26, *a*) which we have just treated of, so closely resembles that of the Grape-vine Plume under consideration, that until the leaves are separated it is almost impossible to tell which larva will be found. Both occur at the same time of year, and both were more destructive than usual the past season in the vicinity of St. Louis. In an ordinary season they do not draw together the tips of the shoots till after the third bunch of grapes is formed, and in devouring the terminal bud and leaves, they do little more than assist the vineyardist in the pruning

* Proceedings for 1860, p. 58, and 1861-2, p. 77.

which he would soon have to give. They act, indeed, as Nature's pruning-knives. But the late and severe frost which killed the first buds last April, so retarded the growth of the vines that the worms were out in force before the third bunch had fully formed, and this bunch was consequently included in the fold made by these worms, and destroyed.

The larva of the Grape-vine Plume invariably hatches soon after the leaves begin to expand; and though it is very generally called the Leaf-folder, it must not be confounded with the true Leaf-folder, which was just now described, and which does its principal damage later in the season. At first the larva of our Plume is smooth and almost destitute of hairs, but after each moult the hairs become more perceptible, and when full grown the larva appears as at Figure 27, *a*, the hairs arising from a transverse row of warts, each joint having four above and six below the breathing-pores * (see Fig. 27, *e*). After feeding for about three weeks, our little worm fastens itself securely by the hind legs to the underside of some leaf or other object, and, casting its hairy skin, transforms to the pupa state. This pupa (Fig. 27, *b*), with the lower part of the three or four terminal joints attached to a little silk previously spun by the worm, hangs at a slant of about 40°. It is of peculiar and characteristic form, being ridged and angular, with numerous projections, and having remnants of the larval warts; it is obliquely truncated at the head, but is chiefly distinguished by two compressed sharp-pointed horns, one of which is enlarged at Figure 27, *c*, projecting from the middle of the back; it measures, on an average, rather more than one-third inch, and varies in color from light green with darker green shadings, to pale straw-color with light brown shadings.

The philosophic student of insect life cannot fail to be struck with the wonderful disguises which these little animals often assume, the better to escape detection from their enemies. The instances of protective mimicry are more numerous among insects than among any other Class of animals, and in the last part of this Report, I shall have occasion to refer to this subject more fully. I had often wondered why the pupa of the Grape-vine Plume was seldom noticed in the open vineyard, and I very well recollect, when three years ago, this worm was abundant in the vineyard of the Rev. Charles Peabody of Glenwood, I. M. R. R., that he one day expressed great astonishment at their total and sudden disappearance. I told him that

* As Dr. Fitch's description of this larva is the only one I know of, and is rather incomplete, I subjoin the following for the scientific reader:

MATURE LARVA OF PTEROPHORUS PERISCELIDACTYLUS.—Average length 0.50 inch. Color pale greenish-yellow. Joints separated by deep constrictions. Each joint with a transverse row of large cream-colored warts, giving rise to soft white hairs, many of which are slightly clubbed at tip. Four of these warts above, and six below stigmata, the four lower smaller than the six upper ones. The hairs from warts above stigmata diverging in all directions and straight, those from the row immediately below stigmata decurving. Other short and more minute club-tipped hairs spring from the general surface of the body between the warts. Head yellow, with labrum slightly tawny. Legs also yellow, immaculate and very long and slender. Described from numerous living specimens.

they had changed to the pupa state and were more thoroughly hidden among the leaves; but he did not succeed in feeding any of the pupæ, and I did not then suspect that we have here a case of mimicry. From some interesting facts communicated to me by Mr. M. C. Read of Hudson, Ohio, I am atisfied, however, that we have here a clear case of protective disguise. He says: "Of a large number raised in jars by me, there were two well defined colors, one a reddish-brown resembling closely the bark of ripe grape wood, the other a light green, or exactly the color of the leaves and young wood. Without an exception the green ones were attached to the green leaves and green wood, or to the sides of the glass jar of very similar color; while all of the brown ones were attached to stems of the ripened grape-wood." Having noted this fact he put large numbers of larvæ in a jar with sticks and material of various colors, but he obtained only the two varieties of pupæ and each was invariably attached to an article of the same color as itself.

So far as I recollect the facts noticed in my own breeding of this insect, they accord with the observations of Mr. Read, and there is no reason to doubt that in a state of nature the green variety confines itself to the leaves, and the brown variety to the wood of the vine. Upon the theory of Natural Selection, *i. e.*, in this case, the preservation of the best disguised specimens, these facts become significant, and it is easy to understand how the two distinct forms would in time inevitably be produced; but whether these singular disguises be explained on that theory or on any other, they are equally interesting and afford good food for the reflective mind.

The moth (Fig. 27, *d*) escapes from this pu a in about one week, and, like all the species belonging to the genus, it has a very active and impetuous flight, and rests with the wings closed and stretched at right angles from the body, so as to recall the letter T. It is of a tawny yellow color, the front wings marked with white and dark brown as in the figure, the hind wings appearin like burnished copper, and the legs being alternately banded with white and tawny yellow.

All the moths of the family (ALUCITIDÆ) to which it belongs have the wings split up into narrow feather-like lobes, and for this reason they have very appropriately been called Plumes in popular language. In the genus *Pterophorus* the front wings are divided into two, and the hind wings into three lobes. As I have shown in my first Report we have a somewhat larger species (*P. carduidactylus*, Riley) which occurs on the Thistle, and which, though bearin a close resemblance to the Grape-vine Plume in color and markings, yet differs very remarkably in the larva and pupa states.

From analogy we may infer that there are two broods of these worms each year, and that the last brood passes the winter in the moth state. I have, however, never noticed any second appearance of them, and whether this is from the fact that the vines are covered

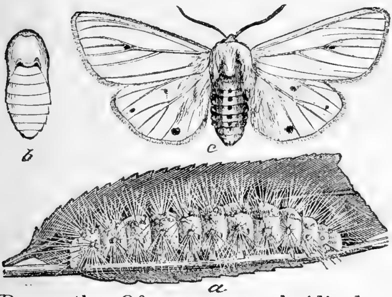
with a denser foliage in the summer than in the spring, or whether there is really but one brood, are points in the history of our little Plume which yet have to be settled by further observation.

On account of its spinning habit, which enables us to detect it, this insect is easily kept in check by hand picking.

THE COMMON YELLOW BEAR—*Spilosoma virginica*, Fabr.

(Lepidoptera, Arctiidæ.)

[Fig. 28.]



This is one of the most common North American insects. The moth (Fig. 28, *c*) which is very generally dubbed "the Miller," frequently flies into our rooms at night; and there are quite a number of our farmers who, somehow or other, have got the idea that this "Miller" is the insect that infests their bee-hives—that it is, in short, the Bee-moth. Of course no such ridiculous idea could for a moment prevail among those who read these Reports.

Though the moth is so common, how few persons ever think of it as the parent of that most troublesome of caterpillars, which Harris has so aptly termed the Yellow Bear (Fig. 28, *a*). These caterpillars are quite frequently found on the Grape-vine, and when about one-fourth grown bear a considerable resemblance to the mature larva of the Grape-vine Plume which we have just described. They seldom appear, however, till that species has disappeared, and may always be distinguished from it by their semi-gregarious habit at this time of their life, and by living exposed on the leaf (generally the under side) instead of forming a retreat within which to hide themselves, as does the Plume.

The Yellow Bear is found of all sizes from June to October; and though quite fond of the vine, is by no means confined to that plant. It is, in fact, a very general feeder, being found on a great variety of herbaceous plants, both wild and cultivated, as butternut, lilac, beans, peas, convolvulus, corn, currant, gooseberry, cotton, sunflower, plantain, smart-weed, verbenas, geraniums, and almost any plant with soft, tender leaves. These caterpillars are indeed so indifferent as to their diet, that I have actually known one to subsist entirely, from the time it cast its last skin till it spun up, on dead bodies of the Camel Cricket (*Mantis carolina*).

When young they are invariably bluish-white, but when full-grown they may be found either of a pale cream-color, yellow, light brown or very dark brown, the different colors often appearing in the same brood of worms, as I have proved by experiment. Yellow is the most common color, and in all the varieties the venter is dark, and there is a characteristic longitudinal black line, more or less interrupted, along each side of the body, and a transverse line of the same color (sometimes faint) between each of the joints: the head and feet are ochre-yellow, and the hairs spring from dark yellow warts, of which there are 10 on each joint, those on joint 1 being scarcely distinguishable, and those on joint 12 coalescing. There are two broods of these worms each year, the broods intermixing, and the last passing the winter in the chrysalis state. The chrysalis (Fig. 28, *b*) is formed in a trivial cocoon, constructed almost entirely of the caterpillar's hairs, which, though held in position by a few very fine silken threads, are fastened together mainly by the interlocking of their minute barbs, and the manner in which the caterpillar interweaves them.

The moth makes its appearance as early as the first of May in the latitude of St. Louis, but may often be found much earlier in stove-warmed rooms. It is easily recognized by its pure white color, by its abdomen being orange above, with three rows of black spots, and by the black dots on its wings. These dots vary in number, there being usually two on each of the front and three on each of the hind wings, though sometimes they are all more or less obsolete, except that on the disk of the front wings.

It is fortunate for us that this caterpillar is attacked by a large number of insect parasites; for, were this not the case, it would soon multiply to such a degree as to be beyond our control. I know of no less than five distinct parasites which attack it—some living singly in the body of the caterpillar, and issuing from the chrysalis without spinning any cocoon of their own; others living singly in the body, but forming a cocoon of their own inside the chrysalis of their victim, and still others infesting the caterpillar in great numbers, and completely filling the chrysalis with their pupæ.*

The best time to destroy these worms is soon after they hatch from their little round yellow eggs, which are deposited in clusters; for, as already intimated, they then feed together.

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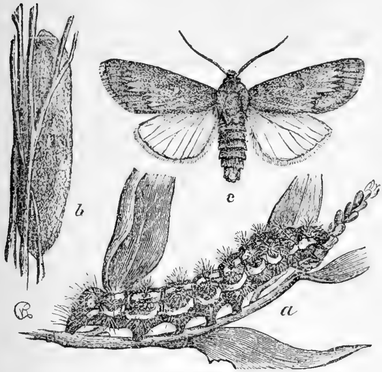
* For the benefit of the scientific reader I enumerate the five parasites which I have ascertained to infest this caterpillar: 1. *Anomalon flavicorne* (Brullé Hym IV, p. 171). 2. *Ichneumon subcyaneus*, Cress. (Proc. Ent. Soc., Phila., III, p. 148), and *Ich. pullatus*, Cress. (Pro. E. S. P., III, p. 146), described as a distinct species, but *pullatus* is evidently the male, and *subcyaneus* the female of the same species, as I have bred from *Spilosoma virginica* three males all answering to the description of the former, and two females both answering to the description of the latter. 3. *Ichneumon signatipes*, Cress. (Trans. Amer. Ent. Soc., I, p. 308). 4. *Ophion bilineatus*, Say, (Ent. of N. A., I, p. 379). 5. A small undetermined, and probably undescribed Dipteron belonging to the MUSCADÆ.

THE SMEARED DAGGER—*Acronycta oblinita*, Sm. & Abb.

(Lepidoptera, Acronyctidæ.)

This is another insect which is occasionally found upon the Grapevine, but never in sufficient numbers to do any considerable harm. It is one of our most common insects, and a very g[illegible]al [illegible]d[illegible]r [illegible]ccurring on a great variety of herbaceous plants, among others asparagus and cotton, and being especially partial to the common smartweed (*Polygonum hydropiper*). It also feeds on some shrubs and trees, occasionaly proving q[illegible]jurious, for Mr. F. A. Nitchy, of Jefferson City, sent me specimens last summer with the statement that they were very numerous on his peach trees, and I have known it to denude both apple and willow trees.

[Fig. 29.]



The larva (Fig. 29, *a*) is easily recognized by the distinct wavy bright yellow band at the side, and the transverse row of crimson-red warts and stiff yellowish or rust-red bristles across each joint, in contrast with the black color of the body. When full grown it draws a few leaves or stems together, or retreats into some fence corner, and spins a narrow elongated cocoon (Fig. 29, *b*) generally white, but occasionally inclining to ochre-yellow, some which I have found on Willow being of this last color. The chrysalis is very dark brown, and, with the exception of a smooth shiny band on the posterior border of each abdominal joint, is rough or shagreened. It has the power of violently turning round and round in its cocoon when disturbed, thereby causing a rustling noise. The moth (Fig. 29, *c*) has the front wings of an ash-gray color, caused by innumerable dark atoms scattered over a white ground, and there is a distinct row of black dots along the posterior border, a more or less distinct black zigzag line across the outer fourth, and some dusky spots just above the middle of the wing. The hind wings are pure white.

There are two broods each year, the first brood of worms appearing for the most part during June, and giving out the moths in July, and the second brood occurring in the fall, passing the winter in the chrysalis state, and producing moths the following May.

Handpicking is the only remedy that it has been found necessary to adopt with this caterpillar whenever it becomes troublesome.

There are at least three natural enemies which serve to keep it in check. The largest of these is the Uni-banded Ichneumon-fly (*Ichneumon unifasciatorius*, Say), a large black fly, 0.60 inch long, and characterized by a white annulus about the middle of the antenna, a large white spot about the middle of the thorax, and a white band on the first joint of the abdomen.

This fly oviposits in the larva of the Smeared Dagger, but the latter never succumbs till after it has spun up and become a chrysalis, for I have always obtained the Ichneumon from the chrysalis. The other parasites are smaller and work differently. They each cause the larva of the Smeared Dagger to die when about full grown, and its contracted and hardened skin, which may often be seen during the winter, with the head attached (Fig. 30, *a*), fastened to the twigs of apple and willow trees, forms a snug little house where the parasite undergoes its transformations and through which it gnaws a round hole (Fig. 30, *b*), to escape the latter part of April. One of these flies (*Aleiodes Rileyi*, Cresson,) is described on page 382, of Volume II, of the Transactions of the American Entomological Society, and is of a uniform reddish-yellow color. The other is a black fly of about the same size, but belonging to an entirely different genus, *Polysphincta*. It has two prominent carinæ on the dorsum of the basal joint of the abdomen, and the legs, except the hind tarsi and last half of hind tibiæ are rufous. It is marked *bicarinata* in my MS., but I omit the description as I do not possess the female. The first of these parasites is in its turn preyed upon by a minute *Chalcis* fly of a steel-blue color with honey-yellow legs, which issues in great numbers through a very minute hole, from the dried caterpillar skins.

[Fig. 30]

As I know of no description of *oblinita* in the English language, and as that of Guenèe is rather summary, I subjoin the following:

ACRONYCTA OBLINITA, Sm. and Abb.—*Imago*—Front wings oblong; apex more or less prolonged; posterior margin sometimes rounded, sometimes straight; color ash-gray, caused by numerous dark brown atoms more or less suffused on a white ground, from which the ordinary lines are barely discernible in the better marked individuals; a row of distinct black dots along posterior border; the ordinary spots represented by blurred marks or entirely obsolete; the undulate line across posterior fourth of wing distinct, and relieved inside by a pale coincident shade, with the teeth quite aciculate and with the psi-spot so characteristic of the genus, but rarely traceable; fringe narrow, and generally entire. Hind wings pure white, with a faint row of dark spots around posterior border. Under side of both wings white with faint fulvous tint and faint irrorations; each wing showing the brown discal spot and the row of points at posterior border. Head and thorax speckled gray; abdomen whitish-gray; antennæ short, simple in both sexes, gray above and brown below; palpi small. Two specimens with the front wings very dark, showing the ordinary lines and spots conspicuously, and with the antennæ brown above as well as below. Average length, 0.75; expanse, 1.75 inches.

Described from numerous bred specimens.

Larva—Prevailing color black. Each joint with a transverse dorsal crimson-red band across the middle from stigmata to stigmata, and containing six warts, each furnishing 10 or 12 or more stiff yellow or fulvous bristles, and the two dorsal ones being farthest apart. A sub-dorsal longitudinal yellow line interrupted by this transverse band and at incisures, in such a manner that the black dorsum appears somewhat diamond-shaped on each joint. A broad, wavy, bright-yellow stigmatal line, containing a yellow bristle-bearing wart in middle of each joint. Lateral space occupied with different sized pale yellow spots, largest towards dorsum. Head chesnut-brown. Venter crimson-

black, with bristle-bearing warts of same color. Stigmata oblong-oval and pale. Thoracic legs black; prolegs with black extremities. Such is the normal appearance of this larva, but it is very variable. In some the yellow seems to predominate over the black, and there is a more or less distinct dorsal line. In some this dorsal line forms a mere speck at the incisures of the middle joints. The transverse crimson band is often entirely obsolete, and the warts distinctly separated, while in others where this band is distinct, the warts frequently coalesce.

Pupa—Almost black, and shagreened with the exception of a smooth and polished rim, at posterior border of joints, which becomes reddish, especially ventrally, on the three joints immediately below wing-sheaths. Terminal joint horizontally compressed, squarely cut off, and furnished with a little brush of short evenly-shorn, stiff rufous bristles.

THE PYRAMIDAL GRAPE-VINE WORM.—*Amphipyra pyramidoides*, Guen.

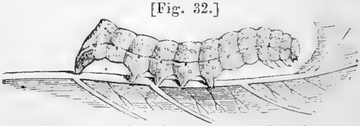
(Lepidoptera, Amphipyridæ.)

Another worm, never hitherto mentioned as injurious to the Grape-vine, is often found resting upon it in the posture shown in

[Fig. 31.]

Figure 32, and may be at once distinguished from all others that are known to attack it, by having a pyramidal hump near the end of its body. This worm I have also found upon the Red Bud (*Cercis canadensis*), the Raspberry and the Poplar, but it is only as a vine-feeder that it can be considered injurious. It was more abundant in the summer of 1869 than it has been since. According to the experience of Mr. G. Pauls, of Eureka, it takes the Hartford, Israella and Iona first, and the Concord and North Carolina next, and devours the blossoms as well as the leaves. It is of the form shown in the figure and of a delicate green color, marked with pale yellow or cream-colored lines and spots, as there indicated. It is found on the vines during the month of May with us, and during the forepart of June descends to the surface of the ground, where it spins a loose cocoon of whitish silk, generally constructed between some fallen leaves. Within this cocoon it remains some time in the larva state, but eventually becomes a shiny mahogony-brown chrysalis from which emerges a moth (Fig. 31), with the front wings bark brown and glossy and marked with dark brown and pale grayish-brown as in the cut; and with the hind wings of a lustrous copper color,

[Fig. 32.]



from which character it may be called in popular language the American Copper Underwing. In Chicago, Illinois, this insect is single-

brooded, for a poplar-feeding larva found the latter part of May, and which spun up on the 14th of June, did not produce the moth till the following April; but specimens obtained near St. Louis often produce the moth during July of the same year that they are found as worms. In this last case a second brood is doubtless produced the same year though it is barely possible that the moths winter over and do not deposit till spring; for they are characterized by having very flat bodies, and with their wings folded flatly on their backs they are often found hiding in narrow cracks and crevices where they seem to love to shelter.

There is an insect (*Amphipyra pyramidea*, Linn.) very common throughout the continent of Europe, on Elm, Poplar, Oak, and other trees, and known in England as the Copper Underwing, which our *pyramidoides*, as its name implies, so very closely resembles in all its stages, that it is difficult for one who has become acquainted with both insects in the field, to bring himself to believe that they are really distinct species. No one can behold the two moths and speculate on their great similarity, without feeling that such close resemblance between the insects of two continents is hard to account for on any other theory than that of community of descent; or without questioning whether there really are differences enough to make two species, when he reflects that far greater variations often occur in the particular species of a given continent! The most constant difference seems to occur in the larvæ which, though they agree in almost every other detail, differ in the European species having the pyramidal hump more strongly developed and capped with a red horn-like point which curves backwards, while in our species this point is more or less obsolete and not red.

REMEDIES.—This worm is easily kept in check by hand-picking, and though its moth is attracted by sweets, it has never been numerous enough in the past to warrant this mode of capturing it. We have no good description of this insect in the English language, so I subjoin one.

AMPHIPYRA PYRAMIDOIDES, Guen.—*Larva*, (Fig. 32.)—Length when full grown 1.20–1.30 inch. Smallest at joint 1, largest at joint 11 which rises pyramidally above the others. Color pale bluish-green inclining to whitish dorsally, and rather darker at each end than in the middle of body. A continuous narrow cream-colored medio-dorsal line extending from the head to extremity of anal shield; a subdorsal line of the same color or somewhat more yellow, wavy and broken into 4 or 5 unequal spots on each of joints 1–10, more or less distinct, ascending continuously on joint 11 to the summit of pyramid, descending in a curve and vanishing in the anal shield; a broader stigmatal line, bright sulphur-yellow, except where intercepted by stigmata where it is white, distinct on joints 1 and 2, less so on 3 and 4, and running straight to the extremity of anal shield. Looking downwards from the top of the pyramid, six lines seem to radiate from it in as many different directions. Besides these lines, each joint has about ten cream-colored piliferous spots, namely, 4 in dorsal space—the anterior ones nearest together—one in the middle of each joint in subdorsal space, and 2 smaller substigmatal ones. These spots are more or less obsolete on the thoracic and anal joints; they are arranged transversely on the former, and the hairs arising from them are so insignificant that they are scarcely visible. Stigmata white, with a black annalation. Head free, smaller than joint 1, concolorous with body. Venter darker green with cream-

colored points. Legs of the same color, the thoracic with three brown, or black spots outside, the prolegs with purplish clingers. Described from two grape-feeding, two poplar-feeding specimens.

Pupa.—Highly polished mahogony-brown, rather short and thick, impunctate, and with two small short spines and several fine curled bristles at the extremity.

Imago.—*Front Wings,* with the costal margin more or less arched and the posterior margin more or less scalloped or dentate; general color brown, being variegated with a pale glossy gray, with more or less fulvous, glossy purple-brown and unpolished purple-black; the transverse anterior nearly obsolete or tolerably well defined, in strong zigzag, pale with a dark shade each side; reniform spot entirely obsolete, or well indicated and pale; orbicular small and illy defined, or large and forming a pale ring with the centre sometimes concolorous, sometimes lighter than median space, and with the basal side sometimes, not always, extended into a beak or point; transverse posterior well relieved inside but not outside, except at costa; it starts distinctly about the middle or a little outside the middle of costa, runs outwardly at right angles along costal nerve, either its own width or twice its width, thence obliquely outwards towards the middle of the wing, with a more or less conspicuous inward jog or curve in discoidal cell; thence across the wing in 4 undulations: in some specimens it makes an obtuse angle, so that the inner half runs parallel with the posterior margin, in others it runs almost straight across the wing, so as not to be parallel with the margin at any point; in some it traverses the wing so as to leave a full third, in others so as to leave only a fourth of the wing outside; subterminal line pale and broken, scarcely distinguishable, or well defined, especially at costa, where the apical space is pale and blends with it, or as brown as the rest of wing and relieves it; a series of 8 more or less distinct pale terminal dots, often relieved by an outer black shade, fringes concolorous: sometimes with a pale middle line often broken and appearing like a second series of dots; the posterior median space is the darkest, and the subterminal space the lightest portion of the wing, though the contrast is often very slight. In one dark specimen the sagittate spots and a longitudinal shade in the discoidal cell and another below the sub-median nerve—the two dividing the wing in three equal parts longitudinally—are very conspicuous from their being very dark and without gloss; in two specimens these marks are entirely obsolete; under surface smoky-gray, more or less suffused with fulvous, and with a dark shade below transverse posterior. *Hind wings* bright glossy cupreous, or with but a very faint tint of this color, and more or less distinctly grayish-brown along the costa to the third superior nerve and the upper posterior border; fringe scalloped, grayish-brown, with an inner paler hue; under surface more or less concolorous, with the lunule indicated and with a broad line, half black, half cupreous. *Thorax,* with the scales large and mixed fulvous and brown. *Abdomen,* with the sides dark, intercepted by the fulvous margins of joints; anal tuft more or less rufous. *Legs* with the tibiæ and tarsi alternately fulvous and brown. Expanse 1.65–1.90 inches.

Described from four bred and four captured specimens.

The differences between the European *pyramidea* and this species, as given by Guenée, are: First, In *pyramidea* the transverse posterior curves outward near the costa, so as to produce an inward sinus in the discoidal cell, while in *pyramidoides* it runs nearly straight and obliquely; Secondly, in *pyramidoides* this line is said to border a median space almost always darker than the rest of wing and absorbing the darker longitudinal lines, while the light lines are given as narrower than in *pyramidea,* and the subterminal more continued to costa, where it borders, or cuts, as Guenée has it, a light apical space. While the difference mentioned in the transverse posterior is tolerably constant in the eight specimens of *pyramidoides* in my possession, I have seen two in other collections where this line was almost a fac-simile of the same line in *pyramidea*; and the other characters, as will be seen from the above description are quite variable, sometimes approaching the typical *pyramidea* and sometimes the typical *pyramidoides.* The same variations doubtless occur in the European species, for if we can rely on Mr. Edward Newman's figure (British Moths, p. 457,) the median space is sometimes as much darker than the subterminal in their insect as it is said, by Guenée, to be in ours Upon critically examining two European specimens of *pyramidea* in the collection of my friend, Mr. A. Bolter, of Chicago, I find this shade very distinct on the posterior portion of the median space, but instead of closely bordering and relieving the transverse posterior it fades somewhat before reaching it. The transverse posterior crosses the wing nearer the middle than in our species, leaving, in one of the specimens, more than one-third of the wing outside. But the distinguishing features which struck me as less subject to variation than those mentioned by Guenée, are the somewhat more elongate wings and the broader, more distinct, subterminal line of *pyramidea.* I have little doubt, however, but that from a hundred specimens of each species at least one *pyramidea* and one *pyramidoides* could be found that were undistinguishable in themselves. The undersides of the two species agree entirely.

There is but one other described, N. A. *Amphipyra,* namely, the *A. inornata* of Grote—(*Pro Ent. Soc, Phil.*, III, p. 86,) which upon the very face of it, seems to be but a small variety of *pyramidoides,* as will be seen by comparing his description with that found above. The species was described from a single specimen belonging to Mr. Wm. Saunders, of London, Ont., who agrees with me in believing it to be but a variety of *pyramidoides.*

I have a unique in my cabinet which differs so remarkably in the front wings from *pyramidoides* that I feel constrained to briefly describe it, and yet in all other characters it so closely resembles that species that I should hesitate to do so, had I not bred it from the larva. It looks exactly as though something had been sprinkled uniformily over the front wings and had eaten the dark color away in spots and splashes, but the specimen is in reality perfect, with not a scale ruffled. It may be called the Spattered Copper Underwing:—

Amphipyra conspersa, N. Sp.—*Larva.*—Found full grown July 2nd, 1867 on Hazel. No pyramindal hump, and of a uniform emerald-green, the dorsal palpitations visible and the stigmata pale with a black annulation, but with no other markings either on the head, body or legs.

Imago—Like *pyramidoides* in every particular except that the brown of front wings is almost uniformily spattered over, more or less suffusely with pale grayish spots so that no regular marks appear. The costal marks are however tolerably distinct as in *pyramidoides* and by careful examination and comparison, traces of the more conspicuous marks of that species may be discerned.

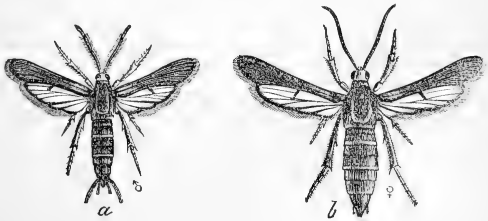
Described from one ♀ bred July 31st.

THE GRAPE-ROOT BORER—*Ægeria polistiformis*, Harr.

(Lepidoptera, Ægeridæ.)

The most common root-borers of the Grape-vine in this State are those which I have termed Gigantic Root-borers, namely, the larvæ of two large beetles (*Prionus laticollis* and *P. imbricornis*) which were treated of in my previous Reports. The insect now under consideration is a moth and not a beetle and has for a number of years been known as THE Grape-root Borer. It bears a very close resem-

[Fig. 33.]



blance to the common Peach Borer, both in habit, and in the size and general appearance of the larva, but it is a somewhat larger insect and the moths differ materially.

It has usually been considered a Southern insect and certain it is that it is not as destructive in the vineyards of Missouri as the Gigantic borers. But I captured specimens of the moth and found the larva in St. Louis county last summer, and it has long been known to be destructive throughout Kentucky. It was also reported around Cin-

cinnati in 1867, though there is no evidence that the insects attacking vine roots there were this species and not the Gigantic borers.

The larva can easily be distinguished from the Gigantic root-borers, by having 16 legs as in all normal Lepidopterous larvæ, namely, six true horny legs head near the and ten false or membranous legs, eight of which are in the middle and two at the end of the body. When full grown it measures from an inch to an inch and three-quarters, and it then forms a pod-like cocoon of a gummy sort of silk covered with little bits of wood-bark and dirt, within or adjacent to the injured root. Within this cocoon it becomes a chrysalis which, in due time, by aid of rows of minute teeth with which it is furnished, works its way out of the cocoon to the surface of the ground, and gives forth the moth. As with the Peach Borer, this insect requires a year to develop and is found in its different states of larva, chrysalis and moth, throughout the summer months, and it doubtless also passes the winter as a larva.

The moth looks very much like a wasp and especially like some belonging to the genus *Polistes*—whence its specific name—and the resemblance becomes still more striking when flying, for its flight is accompanied by a buzzing wasp-like noise. The sexes differ considerably though not as much as in the case of the Peach Borer. The colors are dark brown and tawny-orange, and the male is well represented at Figure 33, *a*, and the female at *b*, but as the description which was published seventeen years ago by Harris, and copied by Mr. Walsh in his Report, is brief and defective, I subjoin one which is more complete:—

ÆGERIA POLISTIFORMIS, Harris,—*Imago* ♀—*Head*, including the palpi, orange-tawny. Antennæ simple, blue-black; orange-tawny above at their extreme base and tip and below for their entire length. *Thorax* black; varied with orange-tawny and bright yellow on the lateral and posterior surface above, and below for its entire surface. *Abdomen* generally with the four basal joints black and the rest orange-tawny; sometimes almost entirely orange-tawny; sometimes almost entirely black; always with a narrow yellow ring at the tip of the second joint above and generally with another such ring at the tip of the fourth joint; venter mostly black with the tip of all the joints more or less edged with orange-tawny, and with a short lateral pencil of orange-tawny hairs springing from the tip of the penultimate joint below, and reaching a little beyond anus. Legs orange-tawny above, mostly black below but with a yellow patch at the origin of the middle spurs on the hind tibiæ. All the spurs and tarsi more or less tinged with yellow. Front wings brown-black with a more or less distinct clear space at base, longitudinally traversed by a nervure; hind wings hyaline, with the veins, the terminal edge and the fringe, brown-black. Length 0.66—0.85 inch; expanse 1.15—1.50.

The ♂ differs from the ♀ as follows:—1st. The antennæ are bipectinate four-fifths of the way to the tip, which is strongly clavate and, as in the ♀, bears a few hairs at its apex. The bipectinations are fully one-fourth as long as the head is wide, and, as well as the entire basal half of the antennæ are orange-tawny. 2nd. Both thorax and abdomen are darker, and in addition to the pair of short anal pencils below, there is a pair nearly twice as long above. 3rd. The short hyaline space straddling a black nervure at base is more distinct. Length 0.68 inch; expanse 1.10 inch.

Described from 1 ♂ 1 ♀ bred July 8th—16th, from grape roots, and others captured during August at Kirkwood, Mo. It is remarkable that although Dr. Harris chronicles in his correspondence with Dr. LeBaron, as a notable event, his having captured an *Ægeria* with pectinate antennæ in New England in 1850,* in 1854, when for the first time he described the moth of our Grape-

*Harris correspondence, p. 262.

root borer, he did not say a single word about the ♂ antennæ being bipectinate, if we are to judge from the account he gives in a Report made to the American Pomological Society in 1854 (p 10.) Either his ♂ specimens had lost their antennæ, or the pectinations were rubbed off, the former being the more likely occurrence. Certain it is that the males received by Dr. Harris once had pectinated antennæ, for though Mr. Glover, copying after Harris, likewise fails to mention this sexual character in his account published in the Patent Office Report for 1854 (p. 80), he nevertheless plainly figures the pectinations (Ibid, Pl. 6, lower right hand figure) and the specimens from which he made the figure were received from the very same person who furnished Dr. Harris with his specimens.

Unlike the Peach Borer which makes its abode quite near the surface, this borer lives exclusively under ground, and unlike the Gigantic root-borers which hollow out and bore up along the heart of the roots, it confines itself almost entirely to bark and sap-wood, and the effects of its work are consequently more fatal to the vine. Roots attacked by it, to use one of Mr. Walsh's expressions, look "as if a drunken carpenter had been diligently scooping away the sap-wood with a quarter-inch gouge." It must, however, sometimes hide under the bark of the roots, as Mr. H. J. Kron of Albemarle, North Carolina, in the Monthly Report of the Department of Agriculture for 1867, (p. 329), describes it as being shielded by the bark.

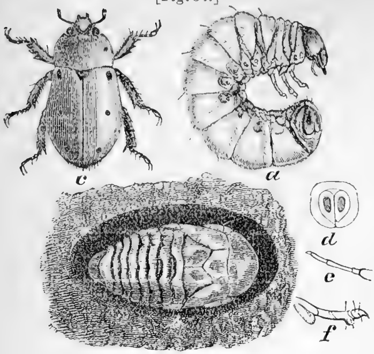
Remedies—It has been ascertained by observation and experiment that the Scuppernong grape-vine—which, according to Gray, is a cultivated variety of the Southern Fox Grape (*vitis vulpina*)—is never attacked by this borer, and consequently that other varieties grafted on to the Scuppernong share its immunity from attack. This is a very easy mode of preventing its ravages in the more Southern States where the Scuppernong flourishes; and if this borer should ever become very numerous with us, it may be deemed advisable to introduce that stock here. At present we have no other preventive than mounding, and the insect is so comparatively scarce that I have not yet had an opportunity of testing whether such mounding would work as well as it does with the Peach Borer. When it is once ascertained that the borers are at work on a vine, they may be destroyed by clearing away the earth and applying hot water to the roots.

THE SPOTTED PELIDNOTA—*Pelidnota punctata*, Linn.

(Coleoptera, Scarabæidæ.)

This is the largest and most conspicuous beetle that attacks the foliage of the Grape-vine, and in the beetle state it seems to subsist entirely on the leaves of this plant, and of the closely allied Virginia Creeper. Though some years it becomes so abundant as to badly riddle the foliage of our vineyards, yet such instan-

[Fig. 34.]



ces are exceptional; and it usually occurs in such small numbers, and is so large and clumsy, that it can not be considered a very redoubtable enemy.

Its larva has, for a number of years been known to feed on the decaying roots of different trees, but was first described by me last September.* It is a large clumsy grub (Fig. 34, *a*) bearing a close resemblance to the common White Grub of our meadows, and it differs from that species principally in being less wrinkled, and in having the chitinous covering (or skin, so-called) more polished and of a pure white color, and in the distinct heart-shaped swelling above the anus (Fig. 34, *d*). Towards the latter part of June I have found this larva in abundance, in company with the pupa (Fig. 34, *b*), in rotten stumps and roots of the Pear. In preparing for the pupa state, the larva forms a rather unsubstantial cocoon of its own excrement, mixed with the surrounding wood. The pupa state lasts but from eight to ten days, and the beetle (Fig. 34, *c*) is found on our vines during the months of July, August and September. It is not yet known how long a time is required for the development of the larva, but from analogy we may infer that the insect lives in that state upwards of three years.

This beetle was named about a century ago by Linnæus who met with a specimen in the magnificent collection of shells and insects belonging to Queen Louise Ulrica of Sweden. It occurs throughout the States and Upper Canada, and is even met with in the West Indies. It flies and feeds by day, and is most abundant during the months of July and August. The wing-covers are of a slightly metallic clay-yellow color, with three distinct black spots on each, and the wings themselves are dark-brown inclining to black; the thorax is usually a little darker than the wing-covers, with one spot each side; the abdomen beneath, and legs, are of a bronzed-green. It is easily kept in check by hand-picking.

PELIDNOTA PUNCTATA, Linn.—*Larva* (Fig. 34, *a*)—Length 2 inches; clumsy, moving on the side. *Head*, bright chestnut-brown, smooth, rounded, with a short, impressed, longitudinal line on the top, and three shallow impressions in front; epistoma trapezoidal and darker; labrum rough, irregularly punctate, and beset on the margin with a few stiff rufous hairs; antennæ (Fig. 34, *e*) as long as epistoma and labrum together, 4-jointed exclusive of bulbus or tubercle in which they are inserted; joints cylindrical, proportioned in length as 2, 6, 4, 1, the terminal joint being often a mere bud; mandibles strong and black, with three denticulations at tip, and a very slight tooth at inner basal portion; maxillæ brown and subcylindrical on outside, angulated on inside, bearing two lobes, each terminating in an inwardly-curved corneous tooth, and each furnished

* See American Entomologist and Botanist, Vol. I, p. 295.

on their inner narrow edge with stiff bristles, the outside one arising close by base of palpus, the inside one extending lower down, and recalling by its form, the terminal joint of the front leg of a scorpion; maxillary palpi 4-jointed, joints cylindrical, short, very gradually longer and longer from 1 to 4, the terminal joint more pointed and narrower than the others; labium quadrangular, labial palpi 2-jointed, the palpigerous piece strongly beset with bristles. *Body*, smooth with but a few wrinkles at thorax; polished translucent white, with faint bluish marblings on all but thoracic joints which are slightly narrower than the rest; a narrow vascular dorsal line, and a very slight yellowish horny plate in a depression on joint 1; a very slight pubescence observable, and a transverse tergal row of sparse but tolerably long hairs on posterior part of each joint; more dense and conspicuous hairs on lower sides of anal joint, which joint is short, cut off squarely, with a heart-shaped swelling [Fig. 34, *d*) sunk into a circular depression, each lobe of the heart with a darker oval corneous elevation; spiracles sub-elliptical, dark chestnut-brown, placed on a prominent swelling, the lateral openings *all* facing the head, the 1st on joint 1, the rest on joints 4, 5, 6, 7, 8, 9, 10 and 11, gradually becoming smaller and smaller from first to last. *Legs* (Fig. 34, *f*) horny, light-brown and covered sparsely with hairs; coxæ long and stout, with a rounded swelling at lower anterior edge; femora cylindrical, sometimes, distinctly, at others indistinctly, separated from tibiæ, sometimes prolonged into a thorn below, with a distinct carina along the inside, at others not; tibiæ cylindrical, incrassated anteriorly, especially below; tarsi cylindrical and terminating in a distinct claw.

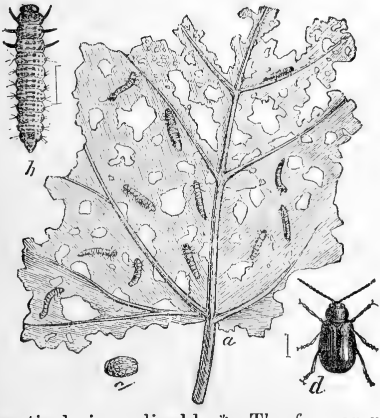
Pupa (Fig. 34, *b*) of the form of *Lachnosterna*.

Described from 12 living specimens.

THE GRAPE VINE FLEA-BEETLE—*Haltica chalybea*, Illiger.

(Coleoptera, Chrysomelidæ.)

[Fig. 35.]



Is there a grape-grower in the State of Missouri who does not know, to his sorrow, what the Grape-vine Flea-beetle is? Hardly one! And yet how few ever connect it with its disgusting little shiny brown larvæ, which generally prove still more injurious than the beetle, by riddling the leaves in the middle of the summer.

The Grape-vine Flea-beetle (Fig. 35, *d*) often goes by the cognomon of "Steel-blue Beetle," and is even dubbed "Thrips" by some vineyardists. The latter term, however, is entirely inapplicable.* The former name is not sufficiently charac-

* The term *Thrips* is confined to an anomalous group of insects—mostly cannibal, but exceptionally vegetable feeding—of which Halliday made a separate Order (*Thysanoptera*), but which are to-day included in the *Homoptera*, or Whole-winged Bugs, by most authors, though they seem to have close affinities to the *Orthoptera*, and to the *Pseudoneuroptera*.

teristic, because the color varies from steel-blue to metallic-green and purple, and because there are many other flea beetles to which it would equally apply.

The Grape-vine Flea-beetle is found in all parts of the United States and in the Canadas, and it habitually feeds on the Alder (*Alnus serrulata*), as well as upon the wild and cultivated Grape-vine. Its depredations seem first to have been noticed in 1831, by Judge Darling, of Connecticut, and in 1834 Mr. David Thomas, of New York, published an account of it in the 26th volume of Silliman's *American Journal of Science*. Its transformations were, however, unknown till some time after Dr. Harris wrote his excellent work on Injurious Insects, and the figure of the larva was first published by myself last fall.

The beetles hibernate in a torpid state under any shelter which is afforded them in the vineyard, such as the loose bark and crevices of stakes, etc., etc., and they are roused to activity quite early in the spring. The greatest damage is done by them at this early season. for they often bore into and scoop out the unopened buds, and thus blight the grape-grower's bright expectations. As the leaves expand, the little jumping rascals feed on the leaves, and soon pair and deposit their small orange eggs in clusters, very much as in the case of the Colorado Potato-beetle. These eggs soon hatch into dark-colored larvæ, which may be found of all sizes during the latter part of May and early part of June. They are generally found on the upper surface of the leaf, which they so riddle and devour as to give it the appearance represented at Figure 35, *a*. When very numerous they devour all but the very largest leaf-ribs, and I have seen the wild vines throughout whole strips of country rendered most unsightly by the utter denudation which these insects had wrought. The larvæ feed for nearly a month, and when full grown present the appearance of Figure 35, *b*, the hair line at the side showing the natural size. They then descend from the vine and bury themselves a short distance in the earth, where, after each forming a little earthen cell (Fig. 35, *c*), they change to pupæ of a deep dull yellow color, and in about three weeks more issue as beetles. These beetles leave the ground from the middle of June to the middle of July, and, so far as I am aware, do not breed again till the following spring—there being but one brood each year. They subsist on the leaves during the fall, but the damage they inflict is trifling compared to that which they cause in spring.

[Fig. 36.]

Like all other Flea-beetles, this species has very stout, swollen hind thighs, which, though hidden in Figure 35, *d*, are well represented in the accompanying cut (Fig. 36). By means of these strong thighs they are enabled to jump about very energetically, and are consequently very difficult to manage during the summer months. In the winter time, however, they can be destroyed in great numbers while hidden

in a torpid state in their retreats, for Dr. E. S. Hull, of Alton, Illinois, tells us* that they were once so numerous in a small vineyard of his that in the spring of 1867 he burnt them out by surrounding them with fire, and letting the fire run through the dry grass in the vineyard. "It was a rough remedy, but as his crop was destroyed, he let the beetles follow suit." Clean culture and general cleanliness in a vineyard will, to a great extent, prevent this insect's increase. Especially should the stakes be clean and free from old bark.

The larvæ can be more easily destroyed by an application of dry lime, used with a common sand-blower or bellows. This has been found to be more effectual than either lye or soap-suds, and is withal the safest, as lye, if used too strong, will injure the leaves.

This insect, like so many others, will one year swarm prodigiously, and then again be scarcely noticed; and such changes in its numbers depend mainly on conditions of the weather, as no parasite is known to attack it. In the spring of 1868, though they were at first out in full force, yet after some subsequent severe and cold weather, they had mostly disappeared. They are apt to be most troublesome where Alder abounds in the woods.

HALTICA CHALYBEA, Illig.—*Full-grown Larva.*—Length, 0.35 inch. Head polished black. Body livid-brown above, paler beneath; subcylindrical, the joints bulging, especially at sides, and each divided superiorly into two transverse folds; on each fold a row of six shiny-black elevated spots, the dorsal ones larger than the others, and often (especially the posterior two) confluent, or divided only by a very narrow dorsal line; each spot giving rise to a single short stiff hair; one such substigmatal black spot placed in middle of joint, and more elongated than the rest, being apparently composed of two confluent ones, as it gives rise to two hairs. Three ventral spots, one anteriorly, which is large, transversely-elongate, central, and without hairs; and two posteriorly (one each side) which are small and piliferous. Six black thoracic legs, and one anal orange proleg.

Pupa.—Length, 0.14 inch. Of the normal Chrysomelid form. Deep dull yellow, and covered more or less above with short black bristles arranged in a transverse row across each joint, and each arising from a slight elevation: two stouter anal bristles or thorns. Eyes brown. Tips of jaws brown.

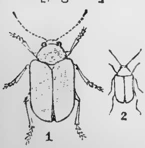
Described from numerous living specimens.

THE GRAPE-VINE COLASPIS—*Colaspis flavida*, Say.

(Coleoptera, Chrysomelidæ.)

There is a little clay-yellow beetle (Fig. 37, magnified, natural size), which does great injury to the Grape-vine by riddling the leaves. It is more or less abundant with us every year, but judging from recorded accounts is still more injurious in the Eastern States, and especially in New York. In the *Country Gentleman* for August 30th, 1866, occurs the following account of it by Dr. Fitch, in answer to a correspondent who wrote that they were destroying grape-vines by the wholesale:

[Fig. 37.]



* Proc. Alton Hort. Soc. for May, 1867.

"The rascals alluded to are a beetle of the Chrysomela family, and are the Brown Colaspis,* *Colaspis brunnea*, Fab. It is an oval, drab-colored beetle, nearly twice as long as broad, and nearly two-tenths of an inch in length, having the outer edge of his wing covers black, and also the under side of its body and the tip of its antennæ. It is rather a common insect throughout the United States, appearing in the latter part of June, each year, and continuing through the month of July. I have frequently gathered it from the wild grape-vine, the Cinquefoil or Potentilla, and some other plants, but have never known it to invade the cultivated grape until this year.

It has this season been the worst enemy that has attacked the vine in my neighborhood—riddling the leaves with small round holes, interspersed with large irregular ones—and I hear of it in several other parts of the country. * * *

Wherever the Leaf-folder (Fig.24) abounds, this beetle will almost invariably be found in conjunction with it in the fold of the leaf. On finding it so invariably in this fold, I at first supposed that it merely took advantage of the position for shelter, little suspecting that it would feed upon the worm, since the family to which it belongs is essentially herbivorous, and the Leaf folder is so very active; but from having found numbers of the shrunken and half-dead worms, I was led to conjecture that it does actually prey upon them; just as many true bugs (*Hemiptera*) though living naturally on the juices of plants, will still appropriate and relish those of certain caterpillars. Thus may one great pest serve to check another!

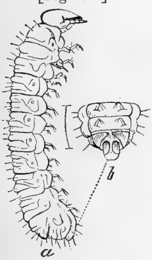
Of the natural history of this beetle nothing has hitherto been known. As the beetle was often found upon and greedily devours the leaves of the Strawberry, and as a white worm was known to injure the roots of that plant, I inferred several years ago (Prairie Farmer Annual 1868, p. 56), that this worm was the larva of the Colaspis. From the facts, however, that the larva of the European *Colaspis barbara* was described as a hexapod, blackish, glabrous grub

* Dr. Fitch referred this insect to *brunnea*, Fabr., and Mr. Walsh (*Practical Entomologist*, II, p. 68) criticised his course, and referred the species to *flavida*, Say. I adopt Say's name simply because it best indicates the general appearance of the insect, and not because I think Mr. Walsh was right in his strictures. I have kindly been allowed to examine Dr. Fitch's specimens; have examined specimens in other large Eastern collections, and those in the Walsh collection, and am convinced that the difficulty between the above two authors arises from the confounding of varieties with species. It is here, as in almost every other genus and Family, the closet systematist divides up and arranges with insufficient knowledge of the variation which species are subject to, and this was especially the case in years gone by, when every little colorational difference was generally supposed to be immutable. The naturalist, therefore, who studies insects for other and more laudable purposes than the mere naming and classifying of them, though fully aware of the importance and necessity of good and clear nomenclature, may well despair of bringing order out of the confusion which often exists, and which the miserably short and incomplete descriptions of older authors have had much to do in causing. The economist can spend his time more profitably, and so long as he always adds the authority to the name he uses, there will be no danger of causing more confusion, and he can coolly disregard the interminable disputes between different authors as to the proper technical name by which an insect should be known. In the present case, I simply give it as my opinion that *brunnea*, Fabr., *suilla*, Fabr., and *flavida*, Say, are all varieties of one species, because specimens according with each are found in the same vineyard, and because Say himself gives a variation in *flavida*, which differs much more from his description than does either *brunnea* tor *suilla*. Mr. Walsh gives the antenna of *flavida* as having the last joint or two, and the tip of the last joint but four, brown-black, but there is variation here, and the dark color on the last joint but four is often obsolete. The exterior edges of the elytra are either concolorous or of all shades of brown to black, and the same may be said of the sutural edges. There is also a somewhat larger form, which must certainly be referred to the same species, which has the punctures so much less profound as to give it a much smoother and more highly polished appearance.

living unprotected upon the leaves of lucern and clover,* and that such was the character of the larvæ of most other insects belonging to the great *Chrysomela* family, I had little confidence that my reference would prove the correct one. Yet it so proved to be, and I have bred the beetle from larvæ infesting strawberry roots that were kindly sent to me by Mr. J. B. Miller, of Anna, Ills. Just as in the European Turnip Flea-beetle (*Phyllotreta nemorum*), the larva mines the leaves above ground, while in our very closely allied Striped Flea-beetle (*Phyllotreta striolata*, Illig.), it feeds upon the roots below ground; so there seems to be the same difference of habit in the genus *Colaspis*. In this last case the difference is not only of habit, but the structure is modified in accordance with the habit, and we have in our Grave-vine Colaspis a Chrysomelid larva bearing a very close resemblance to that of a Lamellicorn.

It is indeed a most singular larva, and differs from all others with which I am acquainted, in having on the underside of the legless joints a pair of curious fleshy projections reminding one of legs, and terminating in about two stiff hairs (Fig. 38, *a*). The office of these appendages it is difficult to conjecture, for they seem to impede rather than aid in locomotion on a flat surface, though, when the habits of the larva are more critically studied, these appendages will doubtless be found to subserve some useful purpose. The color of this larva is yellowish or grayish-white with a gamboge-yellow head. The pupa is formed in the ground and exhibits no unusual characters.

[Fig. 38.]



We are now only treating of this insect as a Grape-vine pest; but it is difficult to say whether the Crown-borer (Fig. 14) or this root-eater is the most injurious to the Strawberry. The work of the two is essentially different, the white Crown-borer confining itself to the crown, and its more dingy ally devouring the fibrous roots and working into the more woody parts from the outside. At this work several of them may frequently be seen with their heads stuck into different parts of one root. They may be found upon the roots all through the fall, winter and spring months, and do not begin to change to pupæ in this latitude till about the month of June, the beetles appearing during that month and continuing to issue from the ground till towards fall. As soon as they issue from the ground they commence to feed upon the tender leaves, and in a measure injure the plants by riddling them with holes. After feeding for a while on strawberry leaves, and depositing their eggs, they spread on to other plants and are generally found most numerous in the vineyard during the latter part of July and during August, where, according to Mr. Miller, they show a partiality for the leaves of the Delaware.

*Notice sur les Devastations de la Larve du *Colaspis barbara*, par M. Leon Dufour—Annales de la Soc. Ent. de France, 1836, pp. 371—372.

Such, in brief, is the history of this common beetle, as far as I have been able to trace it. It doubtless has natural enemies, and ants are so fond of the helpless pupæ that the Colaspis never occurs on the roots where they abound. The evil effects of its work are more apparent on young and newly set plants than on older ones, and the only way to prevent the ravages of the worm, which we yet know of, is to so protect newly set plants that the beetles will not get access to them. I have had no opportunity to make experiments, but it may turn out that some application to the ground or to the plant, such as ashes, soot, lime, or salt, will ward off the perfect beetle, and I shall be glad to hear reports from those who are troubled with the pest. The same remedies used in killing the Colorado Potato-beetle would also kill this species.

COLASPIS FLAVIDA, Say—*Larva,* (Fig. 38)—Color dingy yellowish; uniformly covered with sparse stiff yellowish hairs. Having the general appearance of a Lamellicorn larva. Slightly arched but capable of stretching out tolerably straight. Narrowest in middle of body, the thoracic and anal joints being slightly swollen. The joints with about three dorsal wrinkles to each. Head honey-yellow, rounded, flattened in front; epistoma and labrum of same color; jaws darker. Legs pale, setous, and terminating in a brown claw. Spiracles scarcely perceptible, the first sub-ventral between joints 1 and 2, the others placed on a lateral series of swellings commencing with joint 4. Joints 4-11 inclusive, each with a pair of soft ventral leg-like appendages, ending in two or more stiff hairs. Anal joint somewhat horny below (Fig. 38, *b*) but with no trace of prolegs. Length 0.25—0.30 inch. Described from two rather poor alcoholic specimens.

THE GRAPE-LEAF GALL-LOUSE—*Phylloxera vitifoliæ*, Fitch.

(Homoptera, Aphidæ.)

Here we have an insect, the life-history of which is as interesting to the entomologist as its devastations are alarming to the grape-grower. I have given it considerable attention the past summer, and though it is a difficult task to present definite and satisfactory information from the multitude of facts obtained, yet I shall endeavor to give a comprehensive account of this little louse, so far as my present knowledge of it will permit. In doing so I am made painfully aware that there is much room left for further observations, and he who will patiently and persistently devote his time for a few years to its study, and will with candor and accuracy give to the world the re-

[Fig. 39.]

sults, will doubtless be rewarded by new and important discoveries, and will render valuable service to the cause of science and of economic entomology.

The first reference to this insect was briefly made by Dr. Fitch, of New York, in the year 1856,** and he subsequently described it in a very insufficient manner, under the name of *Pemphigus vitifoliæ*;* but though the specific name must be retained, the insect was wrongly referred to the genus *Pemphigus*, as we shall presently see. Ten years afterwards this louse was again referred to by myself in the *Prairie Farmer* for August 3, 1866, and during the fall of the same year articles were written upon it by Dr. Shimer,† and by my late associate, Mr. Walsh‡—the former claiming that it was a true Plant-louse (*Aphis* family), and the latter that it was a Bark-louse (*Coccus* family). In this Dr. Shimer was evidently right, and Mr. Walsh wrong. In January, 1867, Dr. Shimer proposed for this insect a new family (DACTYLOSPHÆRIDÆ),§ which, in my opinion, cannot stand.

But not to weary the general reader with purely scientific questions, I shall give the reasons for my opinion on this point, together with some other details, in smaller type at the close.

This louse was subsequently treated of by Mr. Walsh in his report as Acting State Entomologist of Illinois (pp. 21-24), where he still felt inclined to place it with the Bark-lice, though I have good reason to believe that he afterwards changed his mind. During all this time a serious disease of the roots of the Grape-vine began to attract attention in the south of France, and it finally caused such alarm that the Minister of Agriculture and Commerce in France offered a prize of 20,000 francs for the discovery of an efficacious and practical remedy.

A special commission was also appointed to draw up a programme of conditions, examine memoirs submitted to it, settle the experiments to be made, collect evidence from local commissions, and if they saw reason for so doing, to award the prize offered by government. The commission consisted of M. Dumas, M. Milne Edwards and M. Duchartre, of the Paris Academy of Sciences; M. Gervais, M. Planchon, M. Henri Mares and M. Louis Vialla, of Montpellier; the Comte de Vergue, of Gironde; M. Bedel, of Vaucluse, and three members of the Ministry of Agriculture.

The disease is known as *pourridie*, or rotting. It is in the form of little cankerous spots, which cut off the supply of nourishment and cause the roots to rot, and these spots were ascertained by MM. Planchon and Lichtenstein, of Montpellier, to be caused by a louse (*Phylloxera vastatrix*, Planchon,) which bears a close resem-

** N. Y. Rep. I, p. 158.

* Rep. 3, § 117.

† *Prairie Farmer*, Nov. 3 and Dec. 8, 1866.

‡ *Pract. Ent.*, Vol. I, p. 111; Vol. II, p. 19; and Proc. Ent. Soc., Phil., VI, pp. 283–4, notes.

§ Proc. Acad. Nat. Sci., Phil., Jan. 1867.

blance to our gall-insect. This is not all, for a leaf-gall absolutely identical with ours also occurs there, and the identity of the gall-inhabiting with the root-inhabiting insect was demonstrated by "J. O. W.," in the *Gardener's Chronicle*, of England, for January 30, 1869, and M. J. Lichtenstein even contended that their European species was identical with ours, and imported from this country, in which opinion he was supported by A. Combe-Dalmas.*

Of course these views expressed in Europe gave increased interest to our own gall-louse, and I determined to make every effort to decide the question of identity, together with some other questions which presented themselves. To this end I opened correspondence with M. V. Signoret and M. J. Lichtenstein, who were making experiments in France while I was doing the same here. But the blighting effects of the war have not only entailed untold misery and woe to millions in France, but have either paralyzed or effectually balked scientific investigation within her borders, so that at last accounts M. Lichtenstein was in Spain, and M. Signoret shut up in Paris.† I was, however, fortunate enough to receive from the latter gentleman, a few days previous to the investment of Paris, a letter stating that upon examination of specimens of our gall-lice, which I had expressed to him, he was convinced of their identity with the European species. This was indeed satisfactory, and coupled with the fact that I have discovered that our gall-insect likewise attacks the roots of our vines in precisely the same manner as does the European species, and that the winged specimens found in this country by Dr. Shimer agree in having the characteristic dusky band around the middle of the thorax described in the winged female of Europe, it leaves no doubt in my mind that the insects of the two continents are really identical.

As already stated, the war put a stop to investigations in France, and we do not know that any effectual remedy was discovered, or that the premium was disposed of. Carbolic acid, and two other substances, namely, sulphuret of lime dissolved in water, and an empyreumatical oil, known among veterinary surgeons by the name of "oil of cade," dissolved in water, were found to be the best specifics; but neither of them have been tried on a sufficiently extensive scale, and I have little faith in any medicinal remedy.

The two parties who have written most upon the disease, namely, Mr. Signoret and M. Lichtenstein, took entirely opposite grounds as to its cause. The former claimed that it had a botanical rather than an entomological cause, that it was principally due to drouth, bad culture and poor soil, and that the *Phylloxera* was therefore incidental; and acting upon this view, suggested that water, with manure

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* *Insectologie Agricole,* 1869, p. 189.

† Since the above was written, I have heard from M. Signoret through M. Lichtenstein. Nothing daunted by the siege, the former carried on his studies of this little louse, and wrote by balloon, that though he himself was reduced to cats, dogs and horse-flesh, the *Phylloxera*, which he had in boxes, kept well and in good health. No doubt our enthusiastic friend finds much solace in thus pursuing knowledge under difficulties.

and good cultivation, would do away with it; while the latter maintained that the *Phylloxera* was the sole cause of the trouble. There are, doubtless, certain conditions of soil which will prove favorable to the increase of the louse, and it may also be influenced by the seasons and by good or poor cultivation; but that this insect should be found only on such roots as are already diseased is highly improbable, and there can be no reasonable doubt that M. Lichtenstein is right in attributing the disease directly to the *Phylloxera*. The appearance of mites is the almost inevitable consequence of diseased and rotting vegetation, but Plant-lice cannot live on such vegetation, and invariably leave it as soon as they have, by their punctures, reduced the healthy tissues to such a state. Moreover, the history of our louse, which I shall now proceed to give, corroborates M. Lichtenstein's views.

In Missouri this insect has proved very injurious to the Clinton vine for several years past—at least as far back as 1864, when the foliage of the Clinton was reported, in the proceedings of our State Horticultural Society, as "very bad"—and Mr. Geo. Husmann informed me that in 1869, it actually defoliated three-fourths of an acre of Clintons and Taylors on bottom land at Bluffton, though it did not appear to do much injury on the hills. It was quite bad around Kirkwood the present year, and, judging from reports, of correspondents and from my own observations, it was more than usually abundant in most of the Eastern States.

In this latitude the first galls are noticed by about the middle of May, and by the middle of June they begin to be quite common. It occurs most abundantly on the Clinton and Taylor, but is also found on the wild Frost Grape (*V. cordifolia*), and such other cultivated varieties of it as Golden Clinton and Huntington; also on the Delaaware, and early in the year I even found a few large galls on the Concord. According to Dr. Morse it also occurs on the Iona, which is a variety of the Northern Fox Grape (*V. labrusca*). The galls vary somewhat in appearance, according to the vine upon which they occur, those I have noticed on the wild Frost Grape being more hirsute than those on the cultivated Clinton, and these again rougher than on the Taylor.

The few individuals which start the race early in the year station themselves upon the upper side of the leaves, and by constant suction and irritation soon cause the leaf to swell irregularly on the opposite side, while the upper part of the leaf gradually becomes fuzzy and closes, so that the louse at last sinks from view, and is snugly settled in her gall. Here she commences depositing, her bulk increasing during pregnancy. Eventually she grows to be very plump and swollen, acquires a deep yellow or orange tint, and crowds the space within the gall with her small yellow eggs, numbering from fifty to four or five hundred, according to the size of the gall. The young lice are pale yellow, and appear as at Figure 40, *d*, *e*. As soon as

they are hatched they escape from the gall through the orifice on the upper surface of the leaf, which was never entirely closed; and, taking up their abode on the young and tender leaves, in their turn form galls. The mother-louse, after completing her deposit, dies, and the gall which she occupied dries up. There are several generations during the year, and this process goes on as long as the vines put forth fresh leaves. As the galls multiply and the growth of the vine becomes less vigorous, the young lice sometimes so completely cover the upper surface of the newly expanded leaves as not to leave room for them all to form galls. In this event the leaf soon perishes, and the lice perish with it. When two or more lice are stationed closely together they often form but one gall, which accounts for the presence of the several females that are sometimes observed in a single gall. Those leaves which have been badly attacked turn brown or black, and sooner or later fall to the ground, so that the vine may become entirely denuded.

By August the insects generally become so prodigiously multiplied that they often settle on the tendrils, leaf-stalks, and tender branches, where they form excrescences and gall-like growths, differing only from those on the leaves in such manner as one would naturally expect from the difference in the plant tissues. By this time the many natural enemies of the lice begin to play sad havoc with them; and after the vine has finished its growth, the young lice, finding no more succulent and suitable leaves, begin to wander and to seek the roots, so that by the end of September the galls are deserted, and those few remaining on the vines generally become mildewy, and finally turn brown and dry up. Upon the roots the lice attach themselves singly, or in little groups, and cause by their punctures little swellings and knots, which eventually become rotten. Where vines have been badly affected with the gall, it is difficult to find a perfectly healthy fibrous root. Strange enough, these lice not only change their residence as winter approaches, from the leaf above ground to the root below ground, just like the Moor, who, having passed the summer on his roof, gets into his house in the winter; but, Proteus-like, they change their appearance in shedding their skins, and at the present writing (Nov. 6th) have all become tubercled, as represented at Figure 40, *g*.

No doubt the insect passes the winter on the roots in this tubercled state, but whether in the spring these tubercled individuals produce winged males and females, which rise in the air, pair, and by depositing eggs give birth to the apterous females which found the gall-producing colonies; or whether, as spring opens, they lay eggs on the roots, and the young hatching from these eggs crawl up on to the leaves and found those gall-producing colonies, are questions yet to be settled in the life-history of our Grape leaf-louse. The former hypothesis is, however, by far the most probable, for analogy would lead us to infer that winged males and females must be developed at some

time during its annual course, and winged males are so rare in the galls that I have never been able to find them, though I have opened thousands upon thousands of the galls during the summer and fall months. Dr. Shimer, indeed, is the only fortunate individual who has found the winged insect in the galls, and, as he himself tells us, he only succeeded in finding four specimens in the fall of the year, after cutting open ten thousand galls; and he has really given us no proof that his winged specimens were really males, and not females. Let us hope, however, that by pointing out the gaps in the biological history of this insect, attention will be drawn to them, so that they may be the more readily filled.

These discoveries lead us to some most important practical considerations. It now becomes evident that this insect can be transported from one place to another on the roots, either upon transplanted vines or in earth containing fibrous roots. Doubtless it was by some such mode as this that the insect was introduced into France from this country. It may be in this manner likewise that it has in part spread from one portion of our country to another, though as it is found indigenously on the wild Frost Grape, the greater probabilities are that it exists wherever this wild grape is found, and has gradually spread from it on to the cultivated varieties. These probabilities are strengthened by the fact that new grape wood is always rooted in the spring, when the lice, according to my views, are leaving the roots. But the important fact remains, that the insect winters on the roots, and that to exterminate it from a vineyard we have but to root up and destroy, late in the fall, such vines as were affected with the galls. From the poor success that has attended the experiments made abroad to destroy the lice on the roots, and from the fact that it is so difficult to reach them, I have little hope that any other remedy will be found than that of extermination by the means indicated, or by plucking and destroying the gall-infested leaves as fast as they appear in the spring.

Another very important practical lesson may be derived from the facts here mentioned, namely, that no variety of the Frost Grape (*V. cordifolia*) should be cultivated and encouraged where those of the Fox Grape (*V. labrusca*) or of the Summer Grape (*V. æstivalis*) are known to be as good. Some of our best grape-growers, especially in the Mississippi Valley, already discard the Clinton and its nearest relatives as worthless, and, considering its liability to this disease, we heartily commend their conduct.

At the 15th annual meeting of the Illinois State Horticultural Society, at Galesburg, the Clinton was highly recommended by Mr. D. B. Wier, of Lacon, Ills., principally for its vinous and medicinal qualities; but in this recommendation he did not meet with much support except from Dr. Hull the State Horticulturist, who also, in the course of his remarks sustained Mr. Wier in his recommendation of the Clinton, though in our own State Horticultural Report for 1864

(p. 66.) he is reported as being much inclined to discard it, his objection being that it is "troubled by the apple-worm"—by which is doubtless intended, the Grape-berry Moth.

There is some difference of opinion among botanists and experienced grape-growers as to the number of indigenous species of the Grape-vine, and as to the true character of some of the cultivated varieties. Some botanists are inclined to the opinion that we have but two, or even but one, species; and certain it is that the fertile character of the hybrids would lead to such an opinion, if infertility of hybrids is to be taken as a test of specific character. But it is more generally accepted that we have four distinct species (*V. labrusca*, *æstivalis*, *cordifolia* and *vulpina*) and this view is held by most western men,* and is perhaps warranted when we reflect that the very term species is but arbitrary, and that fertility of hybrids is not valued so much as an indication of specific identity among plants and some of the lower animals, as it is among more highly organized beings.

As already stated, our Grape leaf-louse is now principally confined to varieties of the Frost Grape;† but as it has been found in limited numbers on Iona and Concord, which are considered as varieties of the Northern Fox, and on the Delaware, which is considered either as a Summer Grape or as a hybrid between the Summer and the Northern Fox, I fear it may yet spread and become injurious to these species. Morever, now that we know that our insect is identical with that of Europe, there is also great danger that it will attack all hybrids with the European *Vinifera*, some of which, as the "Goethe," now promise well. Thus the reasons for discarding the Clinton and other Frost grapes become multiplied, for their cultivation may endanger the whole grape-growing interest of the country. On entomological grounds, I say emphatically to western men, do not plant any more Clintons, and get rid of those you now have as quickly as possible.

At the recent meeting of our State Horticultural Society at St. Joseph, some little discussion followed a paper which I read on this gall-louse and I was pleased to find that Dr. C. W. Spaulding, well known as a successful and experienced grape-grower, together with many other members, fully concurred in the advice here given. He had examined many of his vines, after his attention had been called to the matter, and found that the lice were found principally on the roots of old vines, and not on those of young ones. At this meeting it was almost unanimously agreed that the Clinton was comparatively worthless and should be done away with, but a few of the more

* See Husmann, "Grapes and Wine"; Flagg, *Hearth and Home*, Sept. 3, 1870; Spaulding, Lecture delivered at the Illinois State Fair, 1870.

† Though Gray considers the Clinton a variety of the *Æstivalis*, it is more generally considered as belonging to *Cordifolia*, which its great liability to the gall-louse would indicate.

conservative members, hesitated about discarding it for fear that such action would bring about the very result which it was intended to avoid, *i e.*, the spread of the insect on to other and more valuable varieties. In other words they feared that by taking away the Clinton, the lice which now prefer this variety and flourish and multiply upon it, would be forced to attack other varieties. They looked upon the Clinton, as a protector to the better kinds, by drawing the lice away from them, arguing, to parady the words of Shakespeare, that

"'Tis better far, to bear those ills we have
Than fly to others that we know not of."

Now while I admire the cautious spirit manifested in such an argument and admit that it seems plausible, I cannot believe there is any logic in it. The argument presupposes that the louse, as a species, can suddenly change its habits and tastes when forced to do so ; but to my mind, a new habit is not generally acquired in a species by the simultaneous change of all the individuals composing it, but by some aberrant individual first taking on the new habit, and transmitting that habit to its descendants until a new race is in time produced. A single Clinton vine may stand in the midst of a vineyard of Concords for years, and, as we know to be the case, may be badly infested with this louse without its spreading on to the surrounding Concords. The lice may, and perhaps do, year after year spread on to and settle on the comparatively tougher leaves of such Concords, but year after year they perish from incapacity to sustain themselves. Some day, however, one or more aberrant individuals, may, by some slight constitutional difference from the normal type, be enabled to sustain themselves on the Concord leaves, and, by the laws of inheritance, transmit their characteristics to their descendants until, by the survival of those from each generation best fitted to flourish on these leaves, a new Concord-feeding race will be produced. Therefore, as already stated, I believe that there is danger of this louse spreading on to other varieties, and especially on to such as are more closely allied to the *Cordifolia*, or, to use a common but inexact expression, that have *Cordifolia* "blood" in them. But it must not be forgotten that we are here only supposing, from analogy, what *may* occur, because we know not positively that it *will* occur, and it is very obvious that even if there is this danger the chances of such an occurrence will be far greater as long as the Clinton is allowed to grow in the vineyard, than when it is uprooted and banished ; and so far as all experience goes, we can safely conclude that to destroy all those vines in a vineyard that are infested with this louse, is to banish it from such a vineyard so that it will in future confine its attacks to the wild frost, as it did in the beginning.

The Apple-maggot (*Trypeta pomonella*, Walsh), as Mr. Walsh has demonstrated,* is an indigenous American insect and breeds in our

*Report as Acting State Entomologist of Illinois, pp. 29–30.

wild haws, occurring abundantly in the West, as well as in the East. Of late years it has acquired an appetite for the cultivated apples in some of the Eastern States, where it already does much damage to the apple crop. Yet, strange to say, it has not yet, and may never attack the cultivated apples in the West, and there is more danger that in process of time the more civilized Apple-maggots of the East will spread to the West, than that our haw-feeding maggots which are now among us, will acquire that habit, as a race of them once did in the East. Now no one will argue that if the Apple-maggots of the East were to be exterminated, the maggots in the wild haws would any the sooner attack our cultivated apples; and in like manner the extermination of the lice on our Clinton vines will not cause those on the Wild Frost to any the sooner attack our Concords.

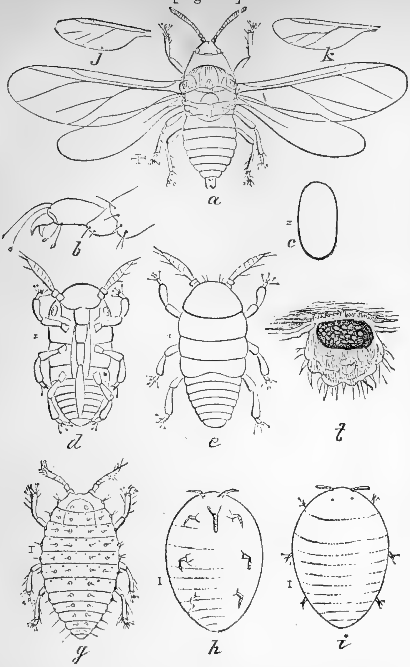
To give another illustration:—Our White pines have for years been greatly injured by the Pine-leaf Scale (*Aspidiotus* [*Mytilaspis*] *pinifoliæ*, Fitch) and I know that this same scale occurs to a slight extent on several other species of the genus, and have good reason to believe that it (or a race of it) is becoming more and more numerous on the Scotch pine around St. Louis. Yet to get rid of this scale I would not hesitate to destroy such White pines as were infested with it, for fear that by such a procedure I should drive the scales on to any other pines; because I believe that the scales on the Scotch pine for instance, multiply among themselves rather than by the annual transportation of individuals from the White pine, and because the experience of the past teaches that the latter is the only pine which has really suffered injury from this scale.

Other similar illustrations might be given, but I close by reiterating the opinion that there is nothing in the past history of the Grape-leaf Gall-louse to warrant the belief that by destroying the Clinton we shall force it on to those more valuable varieties which it has not hitherto attacked, and that whenever, as is admitted to be the case in the central portion of our State, the Clinton can be replaced by other and better varieties, it will be most wise and judicious to discard it. I have no idea that we shall ever exterminate this louse from our vineyards, because we can never obtain concert of action all over the country, and because it will flourish in a measure on other cultivated varieties of the *Cordifolia* group. But let each individual act for himself, and I feel satisfied that so far as he follows the advice here given, just so far will he be benefited.

There are several cannibal and parasitic insects which attack this Gall-louse, but for lack of time to make the proper illustrations, I shall have to leave their consideration to a future Report.

Figure 39, at the head of this article, represents a leaf covered with galls. Figure 40, (*a*) represents the winged female; (*b*) her foot or tarsus—after Signoret; (*c*) an enlarged egg; (*d*) the newly hatched gall-inhabiting type, ventral view; (*e*) same, dorsal view; (*f*)

[Fig. 40.]



a section of a gall; (*g*) the tubercled root-inhabiting form; (*h*) the mother gall-louse at the heighth of her fertility, ventral view; (*i*) same, dorsal view—all from nature; (*j* and *k*) differently veined wings of the Oak *Phylloxera* of Europe. All these figures are greatly enlarged, and the natural size is approximately shown by hair-lines.

The following discussion of this insect's proper place in our classification, and of its characters, may be passed over by the practical reader, as it is intended for those only who take an interest in such questions. I append it with but very slight alteration, as I wrote it for the last number of the second volume of the *American Entomologist:*

It will be remembered that in what was said about this insect on page 248 of our first volume we criticized the founding of the Family *Dactylosphæridæ* by Dr. Shimer. In an essay read before the Illinois State Horticultural Society, at Ottawa, last winter, Dr. Shimer took exception to our remarks, and called upon us to give a reason for the faith that is in us. Not considering a horticultural meeting the proper place to enter into the discussion of purely entomological questions, we declined to waste the precious time of the members, but intimated that we should be glad to answer the Doctor whenever a favorable occasion presented. The opportunity did not offer till now, as the Transactions of the Society, containing the essay in question, have but recently been published, but as we ourselves wrote the strictures, we will briefly give our reasons for so doing. In order to lay the question clearly before those interested, it will be necessary to quote that portion of our former article which so exercised friend Shimer. It runs as follows:

The louse which forms the gall was first described as *Pemphigus vitifoliæ* by Dr. Fitch, of New York, though it does not belong to that genus, Dr. Shimer, of Mt. Carroll, made some interesting observations on the habits of this insect, and made it the type of a new family (*Dactylosphæridæ*) and of a new genus (*Dactylosphæra.*) The distinguishing features of this supposed family are certain appendages attached to the legs which Dr. Shimer calls *digituli*, though the characters of the wings point unmistakably to the genus *Phylloxera* of the true Plant-lice. We shall not now discuss the validity or propriety of this new family, as we intend to give a more complete account of this louse in our future articles on Grape insects; but we will say here that Dr. Shimer is unfortunate in grinding out new genera and new families, for he has proposed a new family and genus (*Lepidosaphes*) for the common Apple-tree Bark-louse (*Aspidiotus*) [*Mytilaspis*] *conchiformis*, Gmél.) based upon similar appendages, which he found on its legs; whereas, if he had been better posted he would have known that these appendages are characteristic of almost all Bark-lice.

And here is Dr. Shimer's appeal:

Here they would like to make the public belive that these appendages, *digituli*, are the characters out of which I have proposed two families in Entomology; whereas, the leading character upon which I propose my family *Dactylosphæridæ*, is two claws on a one-jointed tarsus, and the leading characters in *Lepidosaphidæ* are a tarsus without a claw, and a *scale-making*, not a scale-like insect. The *digituli* from their globe-ended extremities I consider of some importance, but

by no means of primary weight in the first named family, and in the second family I give them no more than secondary importance. What reasons the junior editor, for he alone now becomes responsible, can assign for so gross a misrepresentation I am not able to anticipate. He certainly, however, will be able to give some reason for the faith within him. * * * * * * I have not the slightest personal feeling in the matter, and I hope that my much respected friend, Mr. Riley, State Entomologist of Missouri, will be free to defend the position he has taken against me.

Now, we believe Dr. Shimer is sincere in stating that he has no personal feeling in the matter, else we should not even notice his request. We hope, therefore, that he will believe us when we state that in the few words we are about to pen we are governed by no personal considerations whatever, but by a love of truth for truth's sake. As Dr. Shimer becomes more familiar (and we hope he will so become) with the minute and interesting insects to which he has more especially turned his attention, he will no doubt regret that he ever proposed those two families without longer pondering and considering.

Regarding the Bark-louse, we will dismiss the subject in a few words, as it is foreign to the topic under consideration. Dr. Shimer, it is true, deserves severe handling for the cool and skeptical manner in which he refers to the work of all preceding entomologists, and the laughable way in which he arrogates to himself the power of correct observation;** but at present we will simply accede to his request, as follows:

We confess that in stating that Dr. Shimer had based his new family, LEPIDOSAPHIDÆ, upon the occurrence of *digituli*, we should have qualified our language by inserting "partly" before "upon," since the characters as given by him are, *"Four digituli terminated by pulvilli or arolia, and no claw, and the female living beneath a scale or shell-like habitation of her own constructing."** But we insist that the proposition of a family on such grounds was not only unfortunate, but unwarranted, for the following reasons: First, the so-called *digituli* are not even of generic, much less of family value, as they are nothing but modified hairs, and occur in a more or less perfect form in all young *Coccidæ* and *Aphidæ* which we have examined, and are acknowledged by the best authorities to be common to both these families. Secondly, the insect in question really has a more or less perfect claw, as we have abundantly demonstrated the present year. Thirdly, the assumption† that the scale in all COCCIDÆ should be part and parcel of the insect itself, is a purely gratuitous one, since there are many other species which live separate from their scales, and since the genus *Aspidiotus* was especially erected by Bouché for those species which thus live *under* and seperate from them. Consequently there remains not a single character mentioned by our author but what is well known to belong to the COCCIDÆ, and there is not even the slightest excuse imaginable for seperating it from Costa's genus *Diaspis*, to which it is now correctly referred by Signoret—our highest authority on this family.

Now let us return to our Grape-leaf louse. We have no trouble in proving by Dr. Shimer's own words that we were perfectly justified in saying that the "*digituli*" were the "*distinguishing* features" of his supposed family *Dactylosphæridæ*. The very meaning of the word (globe-fingered) given to the family indicates such to have been the case, and he himself expressly says:‡ "The wing neuration of *Dactylosphæra* is synonymous with that of *Phylloxera*; it is, therefore, upon the other characters that I found this genus." Now what are the other characters? Turning to the family characters given, we find: "Wings four, carried flat on the back in repose. Antennæ few-jointed. Tarsi composed of one joint terminated by two claws, and from two to six *digituli*. Honey tubes none; otherwise resembling *Aphidæ*."§ The only other character given which is not Aphidian is the one-jointed tarsus, which, as we shall presently show, cannot, strictly speaking, be considered a character of our Gall-louse, and which, even if it were, would scarcely warrant the making of a new family. Every other character, including the "*digituli*," is common to dozens of plant-lice, and the neuration of the insect's wing‖ places it beyond any doubt in the genus *Pyllox-*

**Trans. Am. Ent. Soc. I, pp. 371-2.

* Trans. Am. Ent. Soc., I, p. 372.

† Ibid, p. 371.

‡ *Characters for a supposed new family*, p. 5, note; from the Proc. Acad. Nat. Sci., Phil., Jan., 1867.

§ Ibid, p. 1.

‖ The neuration of the wing differs slightly from the typical European *Phylloxera quercus*, in the two discoidal veins of the front wing uniting in a fork instead of being perfectly separated. On this account Mr. Walsh proposed for our insect, and for certain other species found in hickory galls, which have the same neuration, the generic name of *Xerophylla*. But it seems to us that the polymorphism of APHIDÆ has not yet been sufficiently investigated to allow of making even different species, much less different genera, upon a forked or unforked nervure, for there is frequently much greater difference in specimens coming from the same parents; and, as we are informed by M. Lichtenstein, the European *Phylloxera* of the Oak actually presents both kinds of neuration;

era, which has long been ready to receive it, and which, with the genera *Vacuna* and *Chermes*, form the sixth Tribe, *Chermesinæ*, of the APHIDÆ, according to Passerini's latest revision of this family.

We can commend the carefulness with which Dr. Shimer made the interesting observations which he has given us on this insect, but no man should undertake to found new families without first informing himself more thoroughly of what has already been done by others.

It was by no very easy means that we arrived at the conclusion that our Gall-louse is identical with the European species, but now that the fact seems sufficiently proved, Planchon's specific name *vastatrix* will have to give way to Fitch's *vitifoliæ*,* or at the most be retained as a variety.

At first there seemed to be many reasons for considering the two insects distinct. First, the European root-louse was exceedingly destructive, and their gall-louse of only exceptional occurrence; while our gall-louse was very common and destructive, and no root-lice were known to exist here at all. Secondly, the insect found in the galls was smooth, while that on the roots was distinctly ornamented with piliferous tubercles, and the two were sufficiently unlike to cause M. Lichtenstein, who believed in their identity, to propose the term gall-inhabiting (*gallicole*) for the one race, and root-inhabiting (*radiciole*) for the other. Thirdly, our insect was described as having a one-jointed tarsus, whereas M. Signoret described and figured the tarsus of the winged root-inhabiting form as two-jointed. Fourthly, there seemed to be a difference even in the form o our gall-inhabiting louse and theirs, as ours appeared much more obese and globular than theirs, as represented in their figures. All these apparent differences were rather calculated to give rise to doubts as to the identity of the two insects; but by careful observation and persistency we have been enabled to dispel them all.

First, we might naturally expect—and those who believe in the Darwinian hypothesis certainly would—that, presuming our insect to have been imported into Europe, it would undergo some modification in its habits, not only because of change of climate, but because of its having to live on another species of the Grape-vine—all the European species belongs to *Vitis vinifera*. Hence its normal habits there, of feeding on the roots, may have been gradually acquired. We believe a parallel case presents itself in our Apple Root-louse (*Eriosoma pyri*, Fitch) and the Wooly Aphis, or so-called "American Blight" (*Eriosoma lanigera*, Hausm). It is conceded on almost all sides† that the last insect was imported into Europe from this country, and there is now every reason to believe that the two insects are identical, or that at furthest they can only be considered as varieties of one species. Yet while in this country our root-louse is very injurious in the West, and only exceptionally found on the limbs above ground (though more often so found in the Eastern States); all authors that we are acquainted with have spoken of it as occurring solely on the limbs in Europe; though M. Lichtenstein informs us that he has found it on the roots also, and that in those cases it caused just such swellings of the roots as our root-louse does here. We know in St. Louis of an old apple-tree, standing in a yard where the ground is trodden hard, the limbs of which have been for the past three years more or less affected with this insect, though none can be found on the roots. But where the ground is more porous, and not so closely pressed to the roots, it seldom occurs on the branches, but often on the roots, even in the immediate neighborhood. Upon the closest examination we cannot find the slightest difference between the root and branch-inhabiting lice,

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there being red specimens with unforked nerves (Fig 40, *j*) and yellow specimens with forked nerves (Fig. 40, *k*). I have in my possession the very drawing made by Mr. Cresson from Dr. Shimer's specimen of *vitifoliæ*, which Mr. Walsh refers to in his Report, and which led Mr. W. erroneously to place our louse with the Coccids. The drawing is rough, evidently imperfect, and well calculated to mislead, for the discoidal nerve of the front wing is represented more as a fold, the forks are omitted, and the costa of hind wing is represented perfectly straight. The drawing is also accompanied by Mr. Cresson's statement that he could not give any decided opinion as to the neuration, as the wings on the specimen were not spread out.

* M. J. Lichtenstein has objected to Fitch's specific name "*vitifoliæ*" on the score of its being ungrammatical, and has substituted the term "*vitis-folii*" in his published reports. Now Dr. Fitch has given the termination "*foliæ*" to a number of his specific names, and though "*folii*" would of course be more grammatically correct, one would suppose the Doctor had some reason for his conduct. At all events I believe it is perfectly proper to drop the middle *s* in compounding the two words, and certain it is that Fitch's term has been adopted by all subsequent writers in speaking of the insect. Irregularities in entomological nomenclature seem to be allowable, or at least are very frequently and purposely perpetrated for the sake of euphony. "Whatever is, is right," is as true in language as it is in religion, and if we alter *vitifoliæ* we must alter a thousand other entomological names that are not, strictly speaking, grammatically correct. It is quite proper to correct a faulty name, but after showing that it is faulty it seems best, to prevent endless confusion, to adopt the faulty name, and thus make its author shoulder the blame, until he himself corrects it.

† M. Eudes-Deslongchamps and M. Blot are the only authors, according to Amyot and Serville, who believe it is indigenous to Europe.

and no doubt their habitat is governed somewhat by the character of the soil, though in this country their normal habit is to attack the roots, and to appear above ground only occasionly in the fall.

Secondly, we have proved, by transferring on to roots the young grape-lice hatched from galls, and by successfully feeding them on those roots, that our smooth gall-inhabiting type gives birth to the tubercled root-inhabiting type; and we have discovered that our gall insects take to the roots in the fall, on which they cause the same cankerous spots and swellings as does the *vastatrix* of Europe, and on which they evidently hibernate just as *vastatrix* is known to do.

Thirdly, although in the gall-inhabiting type, in both countries, the tarsus seems to be one-jointed, yet in the root inhabiting type it is really two-jointed; for though the basal joint is small, and not visible from above, it is plainly visible from the side or from below (See Fig. 40, *b*). We have here what certain speculative entomologists would consider an excellent illustration of the inferiority of Coccidæ compared with the Aphidæ, namely, a true Aphidian, exhibiting in its larval and agamic stage the one-jointed tarsus of a Coccid, and only showing the two-jointed tarsus of its family in the more perfected tubercled form, and in the winged state. And this Coccid-affinity in the less perfect gall-producing state is sometimes carried still farther, as we have often been unable to discern but a single claw to the tarsi of some of the young gall-inhabiting individuals.

Fourthly, the fact that M. Signoret, who alone has compared actual specimens from both countries, decides them to be identical, would sufficiently indicate that the difference noticeable in the form depends on the observer, and on the stage of growth at which observations are made.

It was the one-jointed tarsus in the gall insect which no doubt in part led Dr. Shimer to propose a new family for it, and it was this character—coupled with the facts that it is oviparous, that does not secrete any sugary or flocculent substance (as do most gall-inhabiting Plant-lice), and that the young forsake the gall and scatter over the leaves as soon as hatched—which led Mr. Walsh to consider it as an anomalous and aberrant Coccid. The genus *Phylloxera* seems also, according to Westwood, to have been doubtingly introduced into this family by Curtis in his Guide. We have already shown that, in the root-inhabiting form, the two joints of the tarsus are plainly to be seen; and Dr. Shimer himself admits* that, in the winged insect which he found in galls, he noticed a constriction on the under side of the tarsus, though he is unwilling to allow that it was a joint, because there was no motion. But even if the 2-jointed character of the more perfect ouse were not demonstrated, all the other characters are so unmistakably Aphidian that there is, we think, no warrant in making a new family. In such degraded insects, where the antennal joints are so variable, we might naturally expect to find variation in the joints of the legs. The more familiar we become with the biological secrets of Nature, the more do we find, not only species but genera, and even families, approaching each other through modifications found in individuals; and these aberrant gall-lice only help to give us a better idea of the close connection between the *Coccidæ* and *Aphidæ*. Our *Phylloxera* brings the two families close together, by its affinities on the one side with *Chermes* of Linnæus, which, though looked upon as a Coccid by Ratzeburg, is generally considered an Aphidian, and on the other with the Coccidan genus *Dactylopius* which contains Linnæus's *Coccus adonidum*. The oviparous nature of these gall-lice will also have less significance when we reflect that there is a sort of gradation in this process, and that many Plant-lice which are considered viviparous or ovoviparous do in reality bring forth their young enveloped in a more or less distinct egg-like film or covering, from which they have to free themselves by a process analogous to that of hatching. This has not only been observed by Curtis, in the case of an *Aphis* found on the turnip,† but by Dr. Wm. Manlius Smith, of Manlius, N. Y.,‡ in the case of *Pemphigus;* but we have, the present year, assured ourselves of the accuracy of Dr. Manlius's observation as to *Pemphigus*, and witnessed the same thing in *Eriosoma*, namely in *E. pyri*, Fitch. In this last case the newly deposited louse (or egg) remains motionless for a considerable time; and the covering, after the young louse has extricated itself from it, may be as distinctly seen attached to the end of its body as the covering or egg-shell of our Grape gall-louse, and was figured by Fitch, who mistook it for the cotton-like matter, which, however, is not secreted till the louse fastens itself and begins to grow.§ Moreover those Aphidians which are viviparous through the spring and summer months, generally lay eggs in the fall; and though agamous and viviparous multiplication can be prolonged by submitting the lice to a continued artificially warm temperature, there is doubtless a limit to this prolongation; and it may be laid down as a rule that, with most Aphidians, the ♂ element and the production of eggs are, at some time or other, indispensable to the continuance of the species.

*Characters of a Supposed New Family, p. 3.
†Farm Insects, p. 65.
‡Auctore Walsh, P. E. S. P. VI, p. 282, note.
§N. Y. Rep. I, p. 9.

THE COLORADO POTATO BEETLE AGAIN.

THE BEST MEANS OF FIGHTING IT—A WORD TO OUR CANADIAN NEIGHBORS.

To give some idea of the onward march of this destructive insect, and to lay before the reader the experience that has been gained since the publication of my first Report, I transmit the following article from the *American Entomologist* of last September.

Last July, while spending a few days in Ontario, we ascertained that this most destructive insect had just invaded the Dominion at two different points, namely, near Point Edward, at the extreme south of Lake Huron, and opposite Detroit, near Windsor, at the south-western corner of Lake St. Clair. These are precisely the two points at which we should naturally expect to first meet with it on the Canadian border; for all such beetles as fly into either of the lakes from the Michigan side would naturally be drifted to these points. As we know from experience, many insects that are either quite rare, or entirely unknown on the western side of Lake Michigan, are frequently washed up along the Lake shore at Chicago; and these are so often alive and in good condition, and so often in great numbers, that the Lake shore is considered excellent collecting ground by entomologists. In like manner grasshoppers are often washed up on the shores of Salt Lake, in Utah, in such countless numbers that the stench from their decomposing bodies pollutes the atmosphere for miles around. We have not the least doubt, therefore, in view of these facts, that the Colorado Potato Beetle could survive a sufficient length of time to be drifted alive to Point Edward, if driven into Lake Huron anywhere within twenty or thirty miles of that place, or if beaten down anywhere within the same distance while attempting to cross the lake.*

How truly is Mr. Walsh's prophecy being fulfilled, that the northern columns of this great army would spread far more rapidly than the lagging southern columns.†

Now, what will our Canadian brethren do? Will they stand by and listlessly see this pernicious insect spread over their territory like a devouring flame, as it has done over the Western and Central States; or will they make some determined and united effort to prevent such a catastrophe? Of one thing our friends across the border may rest assured—they have not here a sham and braggart Fenian army to deal with, but an army which knows no retreat, and whose

*The following item which was clipped from the St. Joseph (Mich.) *Herald*, after the above was written, attests the accuracy of the inference:—"Whoever has walked on this shore of Lake Michigan has observed large numbers of the Colorado potato beetle, crawling from the water. Many have doubted the source whence they came. It would seem from the following that they fly, and swim from the western shore of Lake Michigan. Capt. John Boyne of the Lizzie Doak, reports finding his deck and sails infested with potato bugs when half way from Chicago to St. Joseph at night. Not a bug was on deck when the schooner left Chicago."

†*Practical Entomologist*, I, p. 14.

embers, though of small and insignificant stature, will fully make up in number what they lack in size.

When we calculate the immense loss, amounting to millions of dollars, which this insect has cost the Western States during the past nine or ten years—when we contrast the healthful and thrifty aspect of the potato fields in Ontario and in those States to which this potato plague has not yet spread, with the sickly, denuded, or Paris-green-besmeared fields at home—but above all when we reflect that, nothing preventing, it will infest the whole of Ontario within, perhaps, the next two, and at farthest within the next three years—we feel that it is high time to make some effort to prevent its onward march through Ontario, if ever such an effort is to be made. The warnings and instructions given by the Agricultural press, and through our own columns, will avail but little, as they reach the few only. It may be, and doubtless is, true that successful culture, as our country becomes more thickly settled, will be confined to the intelligent and well-informed; yet the fact nevertheless remains, that the masses will do nothing to ward off an evil until they are forced to it from necessity. The plodding, non-reading farmer will take no notice of the few bugs he first sees in his potato field, because they do him no material injury; but when the bugs have increased so as to make it a question of "potatoes or no potatoes" with him, then his energies will be aroused. But alas! his best efforts, at this time, often prove unavailing, and he has to spend days to accomplish that which a few minutes would have accomplished before. We therefore fully expect to see this great army of bugs continue its eastward march without hindrance, unless other preventive measures are taken than those already employed. A standing premium offered by the Minister of Agriculture, Mr. Carding, for a given number of beetles, or for the greatest number collected and killed in one season, or for the cleanest and best field of potatoes, of a given number of acres, within the infested districts along the eastern shores of the lakes mentioned and those of the St. Clair river; might, and undoubtedly would, be the best means of stamping it out, and of keeping it out of the Dominion.*

No doubt that, in suggesting any expenditure of money for such purposes, our Canadian brethren will deem us over-enthusiastic about "small things," and over-anxious for their welfare. Well, be that as it may, we don't forget that there is considerable of Uncle Sam's territory beyond Niagara. It is a mere matter of dollars and cents, and we venture to say that, when once this insect shall have spread over Ontario, a million dollars would be freely spent to accomplish that which will then be almost impossible, and which a very few thousands would effectually accomplish now—namely, its extermination from the Dominion.

An excellent chance is now afforded in Ontario—almost surrounded as it is by lakes—to keep this destructive enemy at bay. In the summer of 1869, reports of this insect's ravages, and of its prog-

ress eastward, came thick from Wisconsin and Indiana; but no organized effort was made to check it, and indeed there was very little chance of doing so. It is fast spreading through Ohio; and according to Dr. Trimble of New Jersey, has already reached Pennsylvania. Uncle Sam cannot well prevent its spread around the southern shore of Lake Erie, through Pennsylvania and eastward; but, if it can be effectually resisted between Point Edward and the Detroit river, there will be little difficulty in preventing its crossing at Niagara. A victory would indeed be gained if, by intelligent effort, this grievous pest could be kept out of Upper Canada, while it is devastating the potato fields on all sides in the States; and Minister Carding would add to his well-deserved popularity by making the effort, whether it succeeds or not.

PARIS GREEN A REMEDY.

While on this subject it may be well to say a few words about the use of Paris green. This substance has now become THE remedy for the Colorado Potato Beetle, and it is the best yet discovered. Having thoroughly tested it ourselves, and having seen it extensively used, we can freely say that, when applied judiciously, it is efficient and harmless. If used pure and too abundantly, it will kill the vines as effectually as would the bugs, for it is nothing but arsenite of copper (often called "Scheele's green" by druggists), and contains a varied proportion of arsenious acid, according to its quality—often as much as fifty-nine per cent., according to Brande & Taylor. But when used with six to twelve parts, either of flour, ashes, plaster or slacked lime, it causes no serious injury to the foliage, and just as effectually kills the bugs. The varied success attending its use, as reported through our many agricultural papers, must be attributed to the difference in the quality of the drug.

We hear many fears expressed that this poison may be washed into the soil, absorbed by the rootlets, and thus poison the tubers; but persons who entertain such fears forget that they themselves often apply to the ground, as nourishment for the vines, either animal, vegetable or mineral substances that are nauseous, or even poisonous to us. Animal and vegetable substances, of whatsoever nature, must be essentially changed in character and rendered harmless before they can be converted into healthy tubers, and a mineral poison could only do harm by being taken with the potatoes to the table. That any substance, sprinkled either on the vines or on the ground, would ever accompany to the table a vegetable which develops underground, and which is always well cooked before use, is

* The Rev. C. J. S. Bethune, in the *Canada Farmer* for October 15th, 1870, also recommended the marking off of a tract of country about ten miles in width, all along the border line between the foot of Lake Huron and the head of Lake Erie, with the exception, possibly, of a portion of the eastern shore of Lake St. Clair, and stopping the culture of the potato throughout that whole tract during the prevalence of the pest in the neighboring State of Michigan.

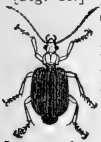
rendered highly improbable. There can be no danger in the use of sound tubers. But the wise and well-informed cultivator will seldom need to have recourse to Paris green, as he will find it more profitable to use the different preventive measures that have from time to time been recommended in these colums.

The poison may do harm, however, by being carelessly used, and it is most safely applied when attached to the end of a stick several feet long, and should not be used where children are likely to play.

NATURAL CHECKS INCREASING.

In many parts of the West this insect is being kept in due check by its cannibal and parasitic enemies, which are still increasing. Thus we learn from many sources that in Iowa and Kansas it is not nearly so injurious as it formerly was, while in some parts of Illinois and Missouri it has also become less troublesome. Last year Mr. T. Glover published the fact that the Great Lebia (*Lebia grandis*, Hentz, Fig. 41) was found devouring its larvæ,* and though hitherto considered rare this Lebia has suddely fallen upon it the present year in many parts of Missouri. During a recent trip along the Missouri Bottom we found this cannibal very abundant in some potato fields belonging to Mr. Wm. Coleman, where it was actively engaged in destroying both the eggs and larvæ of the Potato Beetles. The head, thorax and legs of this cannibal are yellowish-brown, in high contrast with its dark-blue wing-covers.

[Fig. 41.]



This makes fourteen conspicuous enemies of our Colorado Potato Beetle which we have figured, and a dozen more, mostly of small size and inconspicuous markings, might easily be added to the list. Moreover, chickens have learned to relish the eggs, and have even acquired a taste for the young larvæ. So we need not wonder that the army is being decimated in those States first invaded by it.

BOGUS EXPERIMENTS.

It was recently reported to us that a neighbor had succeeded in driving away all his Potato bugs by strewing Elder branches among the vines. We went to examine the field and found our friend enthusiastic over his discovery; and indeed though the vines were nearly devoured, there were but a few full grown larvæ to be found. But, as he could not tell us what had become of the "slugs," we undertook to show him where they had gone, and after digging a few moments with a trowel, unearthed dozens of them, the majority in the pupa, but a few yet in the larva state. Our neighbor had, in fact, been misled by appearances, for want of better knowledge of his enemy. The larvæ as they acquired their growth suddenly became so destructive, that to save his vines he was obliged to try some means of killing them,

* Dept. of Agr. Rep. 1868, p. 81.

and as an experiment he tried the Elder. The larvæ were just ready to disappear of their own accord, and as the great bulk of them did really disappear in two or three days after the application, the apparently logical inference was made that they had been driven away by the smell of the Elder.

How many of the published remedies that flood the country owe their origin to just such defective proof! The sun-scorching remedy, which consists of knocking the bugs off the vines on to the heated ground between the rows, and which has been so often recommended the present year, partakes a good deal of this character; for it can only be of benefit in a very dry season, and at a time of year when the bugs have done most of their damage. A goodly proportion of the larvæ that are thus knocked off will always manage to burrow into the ground and transform, or to get back upon the vines; and

THE TRUE REMEDY

consists in preventing them from becoming numerous so late in the season. Watch for the beetles in early spring, when the vines are just peeping out of the ground. Ensnare as many of them as you can before they get a chance to pair, by making a few small heaps of potatoes in the field planted: to these the beetles will be attracted for food, and you can easily kill them in the morning. Keep an eagle eye for the eggs which are first deposited. Cultivate well, by frequently stirring the soil. Plant early varieties in preference to late ones because the bugs are always more numerous late in the season than they are during the spring and early summer. Give the preference to the Peach Blow, Early Rose and such other varieties as have been found most exempt from attack,* and surround your fields on the outside by rows of such tender-leaved varieties as the Mercer, Shaker, Russet, Pink-eye and Early Goodrich; but, above all, isolate your potato field as much as possible, either by using land surrounded with timber, or by planting in the centre of a cornfield. Carry out these suggestions thoroughly and you will not have much use for Paris green and still less for the scorching remedy.

THE CODLING MOTH AGAIN.—*Carpocapsa pomonella*, Linn.

HAY-BANDS VS. RAGS—ALWAYS TWO-BROODED IN MISSOURI.

After a series of experiments, instituted the past summer, I have proved that, after all, the hay-band *around* the trunk of the tree is a

* After experimenting last summer with eighty-one varieties of potatoes, the Superintendent of the garden of the Iowa Agricultural College reports the varieties of the Peach Blow, the Peerless and Chili No. 2, as most exempt from the ravages of this insect, the last named variety not being worked upon at all.

more effectual trap for the Apple-worm than the rags placed in the *fork* of the tree. There is no superiority in the rags over the hay-band, unless the former are made to encircle the tree as thoroughly as the latter. Where rags are placed simply in the forks, many of the worms pass down the tree from the outside of the branches. If the rag is tied around the trunk, it will impede almost every worm that crawls down the tree from the fruit which hangs on, or that crawls up the trunk from the fruit which alls; and it then has a decided advantage over the hay band, because it can either be passed through a roller or scalded, and used again.

It has been very generally accepted in this country that the Codling Moth is double-brooded, and in all my writings on the subject I have stated it to be so, though no one, so far as I am aware, ever proved such to be the case beyond a doubt. Mr. P. C. Zeller, of Stettin, Prussia, informed me last winter that it is only single-brooded in that part of the world, and Harris gives it as his opinion that it is mostly so in Massachusetts. Now, such may not improbably be the case in northern Prussia, and the more northern of the United States, though I incline to believe otherwise. At all events, this insect is invariably double-brooded in the latitude of St. Louis, and its natural history may be briefly told as follows: The first moths appear, and begin to lay their eggs, soon after the young apples begin to form. The great bulk of the worms which hatch from these eggs leave the fruit from the middle of May to the middle of June. These spin up, and in from two to three weeks produce moths, which pair and in their turn commence, in a few days, to lay eggs again. The worms (second brood) from these eggs leave the fruit, some of them as early as the first of September, others as late as Christmas. In either case they spin their cocoons as soon as they have left the apples, but do not assume the pupa state till towards spring—the moths from the late matured worms appearing almost as early as those from the earlier matured ones. The two broods interlock so that in July worms of both may be found in the fruit of one and the same tree. I have repeatedly taken worms of the first brood, bred the moths from them, and obtained from these m ths the second brood of worms; and I have done this both on enclosed fruit hanging on the tree in the open air, and on plucked fruit in-doors. In the latter experiments the moths would often cover an apple with eggs, so that when the worms hatched they would enter from all sides, and soon so thoroughly perforate and devour the fruit as to die of starvation. This is a clear case of misdirected instinct in the parent, caused doubtless by confinement.

From the foregoing facts, it becomes obvious that the rags or the hay-band should be kept around the tree, say from the first of May till the fruit is all off; and to be thoroughly effectual, the insects collected in or under them should be destroyed regularly every fortnight during that time.

There is a fact connected with the Codling Moth which, though of interest to entomologists is not generally known, and has never been published in this country. It has always been difficult to distinguish the sexes of this moth, but there is an infallible index recently pointed out by Mr. Zeller in his "Lepidopterologische Beobachtungen im jahre 1870." It consists of a black pencil or tuft of hairs of considerable length on the upper surface of the hind wings. It springs from a point close to the base of the wing and by the side of the median nervure, and lies in a groove running alongside of that nervure to about half the width of the wing, the groove forming a distinct carina on the under surface. The tuft when closely fitted into this groove is not easily noticed, but since my attention has been drawn to it, I have readily detected it on all my cabinet specimens, and it can easily be raised by the point of a needle.

Thus we find that important features are often revealed upon close scrutiny of our commonest insects, and the fact that this feature was so long overlooked in our Codling Moth should teach us to be all the more careful and cautious in our examinations and descriptions. Two similar instances of general oversight of common features in common insects were pointed out to me last fall by that excellent observer, Mr. J. A. Lintner, of the Agricultural Rooms, Albany, N.Y., who ascertained the facts that in the Butterfly genus *Argynnis* the males have invariably a beautiful fringe of hair on the sub-costa of the hind wings, while the females have not; and that in the genus *Grapta* the males have hairy front legs while the females have not.*

In my first Report (p. 65) I mentioned as an exceptional occurrence that this insect had been found quite injurious to plums around London, Ontario; but it has not hitherto been recorded as infesting peaches. Mr. Huron Burt, of Williamsburg, Callaway county, informs me, however, that three-fourths of the peaches in his vicinity were infested with this worm, and that it was more abundant in this stone-fruit than in apples, though its gnawings in the former are not followed by the same serious consequences as they are in the latter. In the peach the worm always lives near the stone, and bores no other holes through the flesh than the one required for egress, and the excrement is packed close to the stone, so that the fruit is generally but little injured for eating, cooking, drying or other purposes. Mr. Burt did not actually breed the moths from these peach-inhabiting worms, but as he is one of my most valued correspondents and an excellent observer and has paid considerable attention to insects, I have little doubt but that he is correct in concluding that they were the larvæ of the Coddling Moth, the more especially as he has fur-

* The first mentioned feature, as a secondary sexual character, has long since been pointed out, and according to Mr. H. W. Bates (Trans. Linn. Ent. Soc., Vol. XXIII, p. 502, 1861) is common to all the tropical genera but two (*Lycorea* and *Ituna*) composing the Danoid *Heliconidæ*. Yet Mr. Lintner's observation is certainly original in this country, for, striking and useful as the feature is as a sexual characteristic, it is never given in the beautiful plates of Mr. Edwards's "Butterflies of North America."

nished me, in detail, his reasons for this conclusion; but until the matter is settled beyond all doubt it would be premature to speculate farther on such a new and remarkable habit in such a common and well known insect.

THE CORN-WORM *alias* BOLL-WORM—*Heliothis armigera*, Hübner.

(Lepidoptera, Noctuidæ.)

This is a worm which is every year more or less destructive to our corn in the ear, and which was this year very injurious in many sections.

It has a very wide range, and a Mr. Bond, at the meeting of the London (England) Entomological Society, on March 1st, 1869, exhibited specimens of the moth from the Isle of Wight, from Japan, and from Australia; and, as might be expected from its extended habitat, the insect is a very general feeder. The "Boll-worm" has become a by-word in all the Southern cotton-growing States, and the "Corn-worm" is a like familiar term in those States, as well as in many other parts of the Union; but few persons suspect that these two worms—the one feeding on the corn, the other on the cotton-boll—are identically the same insect, producing exactly the same species of moth. But such is the fact, as I myself first experimentally proved in 1864. It attacks corn in the ear, at first feeding on the "silk," but afterwards devouring the kernels at the terminal end; being securely sheltered the while within the husk. I have seen whole fields of corn nearly ruined in this way, in the State of Kentucky, but nowhere have I known it to be so destructive as in Southern Illinois. Here, as in our own State, there are two broods of the worms during the year, and very early and very late corn fare the worst; moderately late and moderately early varieties usually escaping. I was formerly of the opinion that this worm* could not live on hard corn, and it certainly does generally disappear before the corn fully ripens, but last fall Mr. James Harkness, of St. Louis, brought me, as late as the latter part of October, from a corn field on the Illinois bottom, a number of large and well ripened ears, each containing from one to five worms of different sizes, subsisting and flourishing on the hard kernels. This is, however, an exceptional occurrence, brought about, no doubt, by the long protracted warm weather which we had, and the worms were in all probability a third brood.

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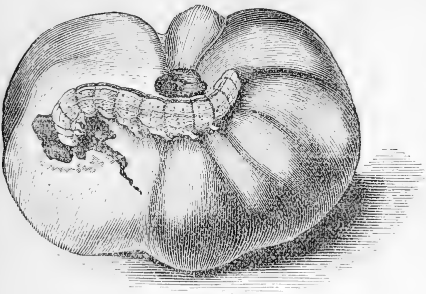
* Am. Ent. I, p. 212.

This glutton is not even satisfied with ravaging these two great staples of the country—cotton and corn—but, as I discovered in 1867, it voraciously attacks the tomato in South Illinois, eating into the green fruit, (Fig. 42), and thereby causing such fruit to rot. In this manner it often causes serious loss to the tomato-grower, and it may justly be considered the worst enemy to the tomato in that section of the country. Mr. Glover also found it feeding in a young pumpkin, and it has been ascertained by Mrs. Mary Treat of Vineland, New Jersey, not only to feed upon the undeveloped tassels of corn and upon green peas, but to bore into the stems of the garden flower known as Gladiolus, and in confinement to eat ripe tomatoes. Last summer it was also found by Miss M. E. Murtfeldt in common string beans, around Kirkwood, and in Europe it is recorded by M. Ch. Goureau* as not only infesting the ears of Indian corn, but as devouring the heads of hemp, and leaves of tobacco, and of lucern. The fact of its attacking a kind of pea, namely, the chick-pea or coffee-pea (*Cicer arietinum*) has also been recorded by M. J. Fallou (See *Insectologie Agricole*, 1869, p. 205) in certain parts of France, the young worms feeding on the leaves but the larger individuals boring through the pods and devouring the peas.

[Fig. 42.]



Thus it seems to be almost as promiscuous in its tastes as the Stalk-borer (*Gortyna nitela*, Guen.), which burrows in the stalks of the Potato, of the Tomato, of the Dahlia, of the Aster and other garden flowers, of the common Cocklebur and of Indian corn, besides boring into green corn-cobs and eating into green tomatoes and ripe strawberries, and in a single instance in Missouri eating into peach twigs, and in Illinois inhabiting the twigs of the Black Currant.†

But for the present we will consider this insect only in the two roles of Boll-worm and Corn-worm, because it is as such that it interests the practical man most deeply.

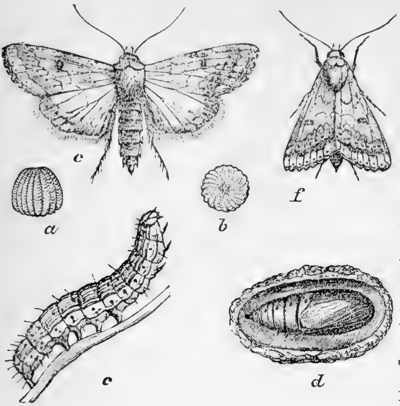
The egg from which the worm hatches (Fig. 43, *a* side view; *b*, top view magnified) is ribbed in a somewhat similar manner to that of the Cotton-worm, figured in my Second Report (p. 38) but may readily be distinguished by being less flattened, and of a pale straw color instead of green. It is usually deposited singly on the outside

* *Insectes Nuisibles*, 2nd supplement, 1865, p. 132.

† See *Am. Ent.* I. p. 206; II. p. 13.

of the involucel or outer calyx of the flower or young boll, and each

[Fig. 43.]



female moth is capable of thus consigning to their proper places, upwards of five hundred eggs. Mr. Glover, in his account of the Boll-worm, published in the Monthly Report of the Department of Agriculture for July, 1866, says: "Some eggs of the Boll-worm moth hatched in three or four days after being brought in from the field, the enclosed worms gnawing a hole through the shell of the egg and then escaping. They soon commenced feeding upon the tender fleshy substance of the calyx, near the place where the egg had been deposited. When they had gained strength, some of the worms pierced through the calyx, and others through the petals of the closed flower-bud, or even penetrated into the young and tender boll itself. The pistils and stamens of the open flower, are frequently found to be distorted and injured without any apparent cause. This has been done by the young Boll-worm; when hidden in the unopened bud, it has eaten one side only of the pistils and stamens, so that when the flower is open the parts injured are distorted and maimed, and very frequently the flower falls without forming any boll whatever. In many cases, however, the young worm bores through the bottom of the flower into the immature boll before the old flower falls, thus leaving the boll and involucel or envelope still adhering to the foot-stalk, with the worm safely lodged in the growing boll. The number of buds destroyed by this worm is very great, as they fall off when quite small, and are scarcely observed as they lie brown and withering on the ground beneath the plant. The instinct of the Boll-worm, however, teaches it to forsake a bud or boll about to fall, and either to seek another healthy boll, or to fasten itself to a leaf, on which it remains until at length it acquires size and strength sufficient to enable it to bore into the nearly matured bolls, the interior of which is nearly destroyed by its attacks, as, should it not be completely devoured, rain penetrates through the hole made by the worm, and the cotton soon becomes rotten and will not ripen. * * * * * * * *
One thing is worthy of observation, and that is, whenever a young boll or bud is seen with the involucre spread open, and of a sickly yellow color, it may be safely concluded that it has been attacked by the Boll-worm, and will soon perish and fall to the ground. * * *

The buds injured by the worm may be readily distinguished by a minute hole where it has entered, and which, when cut open, will be found partially filled with small black grains, something like coarse gun powder, which is nothing but the digested food after having passed through the body of the worm."

This insect is very variable in the larva state, the young worms varying in color from pale green to dark brown. When full grown there is more uniformity in this respect, though the difference is often sufficiently great to cause them to look like distinct insects. Yet the same pattern is observable, no matter what may be the general color; the body being marked as in the above figures with longitudinal light and dark lines, and covered with black spots which give rise to soft hairs. Those worms which Mrs. Treat found in green peas and upon corn tassels had these lines and dots so obscurely represented that they seemed to be of a uniform green or brown color, and the specimens which I saw last summer in string beans were also of a dark glass-green color with the spots inconspicuous, but with the stripe below the breathing pores quite conspicuous and yellow. The head, however, remains quite constant and characteristic. Figure 42 may be taken as a specimen of the light variety, and Figure 43, *c*, as illustrating the dark variety. When full grown, the worm descends into the ground, and there forms an oval cocoon of earth interwoven with silk, wherein it changes to a bright chestnut-brown chrysalis (Fig. 43, *d*), with four thorns at the extremity of its body, the two middle ones being stouter than the others. After remaining in the chrysalis state from three to four weeks, the moth makes it escape. In this last and perfect stage, the insect is also quite variable in depth of shading, but the more common color of the front wings is pale clay-yellow, with a faint greenish tint, and they are marked and varigated with pale olive and rufous, as in Figure 43, (*e* showing the wings expanded, and *f* representing them closed), a dark spot near the middle of each wing being very conspicuous. The hind wings are paler than the front wings, and invariably have along the outer margin a dark brown band, interrupted about the middle by a large pale spot.

Mr. Glover says that there are at least three broods each year in Georgia, the last brood issuing as moths as late as November. With us there are usually but two, though, as already hinted, there may be exceptionally three. Most of the moths issue in the fall, and hibernate as such, but some of them pass the winter in the chrysalis state and do not issue till the following spring. I have known them to issue, in this latitude, after the 1st of November, when no frost had previously occurred.

In 1860—the year of the great drought in Kansas—the corn crop in that State was almost entirely ruined by the Corn-worm. According to the *Prairie Farmer*, of January 31, 1861, one county there which raised 436,000 bushels of corn in 1859, only produced 5,000 bushels of poor wormy stuff in 1860; and this, we are told, was a fair sample

of most of the counties in Kansas. The damage done was not by any means confined to the grain actually eaten by the worm; but "the ends of the ears of corn, when partially devoured and left by this worm, afforded a secure retreat for hundreds of small insects, which, under cover of the husk, finished the work of destruction commenced by the worm eating holes in the grain or loosening them from the cob. A species of greenish-brown mould or fungus grew likewise in such situations, it appearing that the dampness from the exuded sap favored such a growth. Thus decay and destruction rapidly progressed, hidden by the husk from the eye of the unsuspecting farmer." It appears also that many horses in Kansas subsequently died from disease, occasioned by having this half-rotten wormy corn fed out to them.

REMEDIES.—It is the general experience that this worm does more injury to very early and very late corn than to that which ripens intermediately, for though the broods connect by late individuals of the first and early individuals of the second, there is nevertheless a period about the time the bulk of our corn is ripening, when the worms are quite scarce. I have never yet observed their work on the green tassel, as it has been observed in New Jersey, and do not believe that they do so work with us. Consequently it would avail nothing as a preventive measure, to break off and destroy the tassel, and the only remedy when they infest corn is to kill them by hand. By going over a field when the ears are in silk, the presence of the worms can be detected by the silk being prematurely dry or by its being partially eaten.

In the South various plans have been adopted to head off the Boll-worm, but I believe none have proved very successful. The following experiment with vinegar and molasses, was made by B. A. Sorsby, of Columbus, Ga., as quoted by Mr. Glover:

"We procured eighteen common-sized dinner plates, into each of which we put half a gill of vinegar and molasses, previously prepared in the proportion of four parts of the former to one of the latter. These plates were set on small stakes or poles driven into the ground into the cotton field, one to about each three acres, and reaching a little above the cotton plant, with a six-inch square board tacked on the top to receive the plate. These arrangements were made in the evening, soon after the flies had made their appearance; the next morning we found eighteen to thirty-five moths to each plate. The experiment was continued for five or six days, distributing the plates over the entire field; each day's success increasing until the numbers were reduced to two or three moths to each plate, when it was abandoned as being no longer worthy of the trouble. The crop that year was but very little injured by the Boll-worm. The flies were caught in their eagerness to feed upon the mixture by alighting into it and being unable to escape. They were probably attracted by the odor of the preparation, the vinegar probably being

an important agent in the matter. As the flies feed only at night, the plates should be visited late every evening, the insects taken out, and the vessels replenished as circumstances may require. I have tried the experiment with results equally satisfactory, and shall continue it until a better one is adopted."

Mr. J. M. Heard, of Monroe county, Wisconsin, patented in 1860, a device for trapping the moth, which consists of a tin plate placed on a funnel, which is connected with a bait-pan made of the same material, and which is to be partially filled with molasses mixed with a little anise, fennel or other essential oil. From one summer's test of the trap, I do not think much of it as a decoy for the moth, and it would be altogether too expensive, when the great number required to properly protect a large cotton field is taken into consideration.

THE FALL ARMY-WORM—*Prodenia autumnalis*, Riley.

[Lepidoptera, Noctuidæ.]

In 1868 the true Army-worm appeared in certain portions of the State and I gave a full account of it in my second Report. Last fall another worm very generally mistaken for that insect made its appearance very generally over the State, and caused considerable alarm. Specimens were sent to me from Moniteau, Jefferson, Pulaski and Cole counties, while it was common throughout the greater portion of the county of St. Louis.

The first notice I received of it was from the following item which appeared in the *Journal of Agriculture* of St. Louis:

ARMY WORM.—*Editors Journal Agriculture:* Since Friday (26th August), the Army-worm has made its appearance in distressingly large numbers almost everywhere in this (Cole) county. They have destroyed for me more than an acre of turnips, a good deal of my late soiling corn, and are still on the march for more. Farther in the country they have eaten up the buckwheat, which is just coming into bloom. Could our esteemed friend RILEY give us an article in the next *Journal?—F. A. Nitchy.*
JEFFERSON CITY, Mo., August 29th, 1870.

The following published paragraphs, which all refer to this same worm, and which chanced to meet my eye, will give some idea of the extent of country through which it ranged.

FALL ARMY-WORM.—We have received specimens of the Fall Army-worm from several persons. The complaints of its ravages are quite numerous almost all over the State; they are very bad in northeast Missouri. Threatening at Tipton, from which place we have samples, and in St. Louis and Jefferson counties they are quite bad. This pest only returns at intervals, perhaps on account of parasitic

and other enemies gaining the ascendancy over them.—*Rural World, Sept. 2nd,* 1870.

ARMY-WORM IN CALLAWAY COUNTY.—I have found that the Army-worm has been more or less on almost every farm, and have been examining some of the meadows over which they have passed, and have come to the conclusion they are about ruined. From my examination I think that nineteen-twentieths of the grass is entirely killed; at least there is not more than one balb in twenty that shows any signs of vitality. Why should this insect make its appearance at this season? Mr. Riley, I believe claims that it makes its advent in the spring. But now we have it appearing at the end of summer and beginning of fall, and in numbers as great and as destructive as ever it did in spring. Could it be that the extreme heat of this season, with favorable conditions of moisture, has brought them forth prematurely? I noticed that some plum trees, cherry trees, smoke trees, summer roses and strawberries are blossoming freely from premature development.—*H. B., Journal of Agriculture, Oct. 13th,* 1870.

The Army-worm, on the 28th of August, appeared in force in my neighbor's wheat stubble, moving south towards a piece of land that I had planted in corn, and then sown in rye that was up nicely. When they reached the fence (which they did on the 28th of August), I scattered salt thickly on the rich blue grass on my side of the fence, all along it, while the dew was on. They came no further. As I was obliged to be away from home, I cannot say whether the salt checked them or not—at any rate, it caused the grass to wilt and die.

A very small dark worm about halt an inch long, has been doing some damage to the young grain of late.—*J. L. Erwin, Fulton, Callaway County, Mo.*

THE ARMY-WORM—A SLANDER ON THE BIRDS—*Editor Farmer:* Feeling it a duty, as well as a privilege, to contribute all good, or even really bad news for the farmers, through your truly valuable and very much improved and highly esteemed Farmers' journal, enclosed (in a small phial) please find some specimens of Army-worm, many millions of which infest our county. They are everywhere. It is said they are brought by a small, yellow bird, which goes in covies of twenty-five to two hundred—that wherever they alight, the worms first appear. It is said that each petaled portion of the feathers is covered with nits, and their number is legion.

We would be pleased to hear from some of our scientific men on the subject, as we are very much interested. They take a twenty-acre wheat field in two days.

These pestiferous little pests are rapidly arriving at maturity. In traveling, their course seems westward. They last appeared here in 1866, but too late in the season to do any great damage, as a cold rain sent them the way of all the earth. That being in October, nothing of the kind can be expected at this time; and if they are to remain here until October, woe to our wheat fields in this vicinity!

MINERAL POINT, Kansas, Aug. 29th, 1870.

[The above letter came to us too late for insertion last month. Our friends are doing great injustice to our little harmless "Prairie-birds," in supposing that they have anything to do with bringing the Army-worm—EDITOR].—*Kansas Farmer, October,* 1870.

ARMY-WORM.—Late rains are keeping corn too green. Too muddy to plow for wheat. The Hessian-fly and Army-worm are too numerous to allow farmers to seed much this fall. The early sown wheat

and much of the meadows are eaten up by the Army-worm. Dr. C. W. Thornton, of Warrensburg, Kansas, in *Kansas Farmer.*

ARMY-WORM.—We have received from S. S. Tipton, of Mineral Point, a specimen of the above genius, but a little the worst demoralized specimen we ever saw. The bottle was broken, and, as well as we can determine, by the aid of a powerful magnifying glass, the worm is in about sixty thousand pieces. We shall refer to the subject in our next; but in the mean time, we advise our friends to plow and scrape out ditches, in which to spread dry straw. Then muster your force armed with brushes, drive them into the ditches, and set fire to the straw. We have seen them very successfully treated in this way. *Kansas Farmer.*

Thus in all the above accounts this worm was supposed to be a fall brood of the true Army-worm, and in the following letter, we shall see that it was also mistaken for the Corn-worm treated in the last article—a mistake not at all surprising considering the close resemblance between the two worms,

C. V. Riley, Dear Sir.—I herewith send you a box of what I believe to be the Boll-worm although its actions here were similar to the true Army-worm. At my father's and in the neighborhood they complain too of *the Army-worm* eating up the young oats and timothy. With me they commenced about two weeks ago in a field of young oats, or rather oat stubble which had been plowed under and sown to buck-wheat. The oats had got to be about six inches high and were eaten first, next the worm took what little crab grass they could find and they are now scattered, eating grass, corn silks, soft corn, rutabaga leaves and whatever in the grass line comes before them. They have not entered my meadow yet, nor a piece of wheat stubble which is plowed under. G. PAULS.

Eureka, Mo., Sep., 7, 1870.

On the farm of Jno. J. Squires at DeSoto, this worm at first ate off all the grass, then completely stripped the leaves from some corn-fodder, injured his corn, ate into his tomatoes and ruined his turnips —injuring his crops to the amount of nearly $1,000.

In some cases the worm acted strangely, and I have know it to take a whole field of rye in preference to wheat. Judge Wielandy, of Cole county informs me that it was abundant on his potatoes, cutting off the lateral stems. It invaded a large cucumber field and entirely cleaned out the crab grass, and would have injured his cucumbers had he not applied slacked lime. In some parts of Jefferson county it was very abundant and destructive, and Senator J. H. Morse, of Morse's Mills had twenty acres badly injured by it. I have also been informed that in some vineyards it did great damage by gnawing around the stems and causing the bunches to drop off and fall to pieces so that the grapes would scatter on the ground. But I cannot vouch for the correctness of the observation. With me it did more injury to corn than to anything else. It not only greedily devours the leaves and stems, but bores large holes through the ears, burrowing in them in all directions. On late corn it is frequently found in the same ear with the Corn-worm, *alias* Cotton Boll worm. The Boll-worm is,

however, rougher, generally paler, striped differently (see Figs. 42 and 43, *c*,), and always readily distinguished by having a larger gamboge-yellow or reddish head, which invariably lacks the distinct white inverted Y-shaped mark, and the darker shadings of the head of the Fall Army-worm.

Now, until the present year nothing was absolutely known of the natural history of this worm, and though I knew that it was not the true Army-worm, and suspected, from comparing it with the description of certain corn-feeding worms received in 1868 from Mr. E. Daggy, of Tuscola, Illinois, that it would produce a certain moth which I bred from Mr. Daggy's worms—yet I could not feel positive without breeding the Fall Army-worm to the perfect state. This I very luckily did, and I am therefore able to give its complete history.

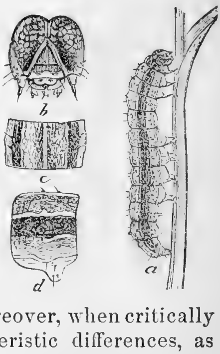
In the fall of 1868 I received a few specimens from Mr. T. R. Allen, of Allenton, with an account of their injuring newly sown wheat on oat stubble, and on page 88 of my first Report it was briefly described by the name of Wheat Cut-worm. The popular term of "Fall Army-worm" is, however, altogether more indicative than that of "Wheat Cut-worm," since the species does not confine its attacks to wheat, and not only very closely resembles the Army-worm in appearance but has many habits in common.

HOW IT DIFFERS FROM THE TRUE ARMY-WORM.

The two insects need never be confounded, however. The true Army-worm never appears in the fall of the year, but always about the time when wheat is getting beyond the milk state; and it generally disappears, in the latitude of St. Louis, by the first of June. It confines its attacks entirely to the grasses and cereals, whereas the species under consideration is a much more general feeder, devouring with equal relish most succulent plants, such as wheat, oats, corn, barley, grasses, purslane, turnips, and, as Mr. J. M. Jordan of St. Louis informs me, even spruces. Moreover, when critically examined, the two worms show many characteristic differences, as will be seen by comparing Figure 44, which represents the true Army-worm, with Figure 45, which represents at *a* the Fall Army-worm natural size, at *b* its head magnified, at *c* a magnified dorsal view of one of the joints, and at *d* a magnified side view of same.

[Fig. 44.]

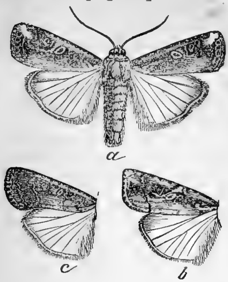
[Fig. 45.]



Our Fall Army-worm moth is a most variable one—so variable,

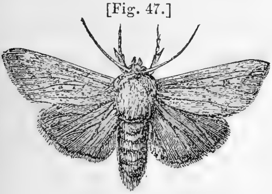
indeed, that at least three species might easily be fabricated by any species-grinder who happened to capture at large the three most distinct varieties, without knowing anything of their transformations. I have bred 31 specimens, all from larvæ found on corn, and have others which were captured at large, and though half a dozen sufficiently distinct varieties might easily be picked out from among them, and though scarcely any two are precisely alike, yet they may all be divided into three distinct sets or varieties. The first of these, which is the more common, is represented at Figure 46, *a*, the second at *b*, and the third at *c*. For those who are more curious in such matters I append, at the end of this article, a more elaborate description of this new moth. Not only do I find this great variation in this particular species, but all the species of the genus to which it belongs are variable; and Guenée has truly remarked that they resemble each other so closely, and their modifications are so complicated, that it is next to impossible to properly separate them. By comparing the annexed Figures 46 *a*, *b* and *c*, with that of the true Army-worm moth (Fig. 47) the two insects will be found to differ widely.

[Fig. 46.]

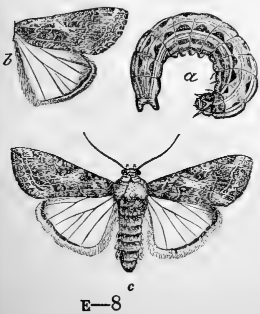


We have in this country a very common moth (*Prodenia commelinæ*, Abb.) which may be popularly called the Spiderwort Owlet moth, some of the varieties of which approach so nearly to some of the more strongly marked varieties of our Fall Army-worm moth that it is necessary to show the very great difference which really exists between them, in order that the cultivator may not be unnecessarily alarmed when he observes the former, by confounding it with the latter, and erroneously inferring that he will be overrun with Fall Army-worms when there is no real danger. The Spiderwort Owlet moth, (Fig. 48, *b* and *c*) is a handsomer and more distinctly marked species, the front wings inclining more to vinous-gray, or purplish-gray, and the ordinary lines being more clearly defined by very deep brown, than in the Fall Army-worm moth. But, however much these characters may vary—and they are quite variable—there are yet two others which will be readily noticed upon comparing the figures of the two species, and by which the Spiderwort moth may always

[Fig. 47.]



[Fig. 48.]



be distinguished from its close ally, namely, by the tip of the wing being more prolonged and acuminate, and by the three-forked nerve in the middle of the wing being much more conspicuous. Its larva never congregates in multitudes as does the Fall Army-worm, and differs so materially from that worm, and is withal so characteristically marked, that it may be recognized at once by the above illustration (Fig. 48, *a*). Contrary to what its name would indicate, it is a very general feeder, as I have found it on all sorts of succulent plants, both wild and cultivated, This insect is more or less numerous every year, but has never been known to multiply so prodigiously as the Fall Army-worm, which we have under consideration. It passes the winter either in the larva, pupa or perfect state, but more generally in the former.

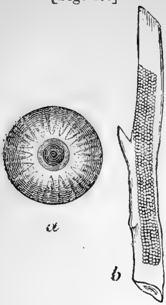
REMEDIES.

Now that I have sufficiently dwelt on the characteristics of the Fall Army-worm to enable any one to distinguish it, even from its nearest relative, let us consider for a moment what can be done to prevent its great injuries to grains and to vegetables. I have proved that there are at least two, and probably as many as three or even four broods during the course of the year; for those worms which appeared in such multitudes in August and the forepart of September, in due time produced moths, and these gave birth to a new generation of worms, which began to make their presence manifest towards the end of October. In 1868, also, I bred the moth as early as July, from worms received from Mr. Daggy. In this prolificacy the Fall Army-worm differs remarkably from the true Army-worm, as well as from most of its close allies, which generally produce but one, and seldom more than two, broods each year.

The moths were so numerous during the latter part of September and the forepart of October, that I not only found them common at Decatur, Vandalia and other parts of Central Illinois, and wherever I traveled in our own State, but I captured a goodly number in the very heart of St. Louis, and even caught some while riding by rail.

The eggs are deposited in small clusters, often in two or three layers one above the other, and the whole cluster is covered sparsely with the yellowish hairs from the ♀ abdomen. Each egg is nearly spherical, of a pale fulvous color, and differs only from that of the Unarmed Rustic (*Agrotis inermis,* Fig. 49, *a*, showing one magnified, and *b*, a batch of natural size,) in being less compressed and less distinctly ribbed. The clusters were found abundantly, not only on the under side of peach and apple leaves, which the worms readily devour, but on the leaves of such trees as sycamore, which, so far as we at present know, they do not feed upon. Under these last circumstances the young worms, upon hatching, would soon descend the tree to feed upon the more succulent herbage below; and the more I learn of the habits of our different Owlet moths,

[Fig. 49.]



a *b*

the more I become convinced that the long-accepted theory of their eggs being deposited on the ground is a false one, and that most of our cut-worms though fat, lazy and groveling in the ground when we find them, have been born in more elevated and exalted positions.

In the fall of 1868 this worm proved very destructive to the newly sown wheat in many parts of Franklin and St. Louis counties, Mo., and seemed to be confined to such wheat as was sown on oats stubble. I then accounted for this singular state of things by supposing that the scattering oats which were left after harvest had sprouted before the wheat, and had thus attracted the parent moths*; and, acting upon this supposition, I suggested that the attacks of the worm might effectually be prevented by plowing the land early and keeping the ground clear of all vegetation until the wheat was planted. This inference proves to be well warranted by the facts; and in future, when the Fall Army-worm is heard of during the months of August or September, as it was the present year, it will be wise for those who live in the immediate neighborhood, either to sow no fall grain at all or to endeavor, in doing so, to carry out the above suggestions. The last brood of worms, which at this writing (Nov. 7th) are not yet quite full grown, must evidently pass the winter in the ground, either in the larva or the pupa state. In either case a great many of them would be killed by late fall plowing which should be used, when practicable, as a remedial measure in fields where this insect has been numerous. When the worms are overrunning a field of fall grain, most of them could be destroyed by means of a heavy roller, without injury to the grain.

The question has been repeatedly asked: "Will this worm be as numerous next year as it has been this; or will it go on increasing in geometrical ratio, and be still more numerous?" Now, although I greatly dislike to weaken the confidence that some people seem to place in the oracular power of an entomologist to peer into the future, yet I must meekly confess my inability to give any definite answer to such questions.

Byron has truly said that, "the best of prophets of the future is the past;" and we may reasonably draw the inference that this worm will *not* be so abundant next year, because in the past it has only occasionally been so troublesome, and never, so far as the record shows, during two consecutive years. And we may rest tolerably well assured that it will not increase in geometrical ratio, because most vegetable feeding insects are preyed upon by more predaceous

*Report I, p. 88.

species and by parasites,* and because such continued increase of one species is inconsistent with the harmony we find everywhere in Nature. But we may not venture beyond the inference, as the happenings of the future are not for mortals to know. Some persons may also be curious to learn why this worm increases so much more in late summer and fall than in spring, since there are so many broods during the year; or why it is only noticed in certain years? Such questions, likewise, can receive no definite answer,

"Till old experience do attain
To something like prophetic strain."

For though, to meet the first, we may assume that the winter decimates their numbers, or that the spring weather is not favorable to their increase; and to meet the last we may conjure up a hundred reasons yet assuming is not knowing, and we must content ourselves with the facts as they occur.

In conclusion, it will afford a grain of comfort to those who have had wheat fields cleaned off by this worm, to know that their wheat is not necessarily ruined; for, as I personally ascertained, wheat that had been thus cut off in the fall of 1868 made a good stand the following spring; and in one instance, where part of a field had been invaded and the rest left untouched, it really appeared that the part which had been eaten off yielded the heaviest. Mr. Huron Burt, of Callaway county, Mo., also informs me that this insect always leaves blue-grass untouched.

PRODENIA AUTUMNALIS, Riley.—*Imago* (Fig. 46, *a*, *b* and *c*.)—*Front wings* narrow with the apex usually well rounded, and with the middle of the hind margin sometimes, but not often, extending beyond apex: general color mouse-gray variegated with smoky-brown, fulvous and pearly or bluish-white; apical patch bluish-white and never extending beyond nerve 5: the subterminal line—which is pale and bends like a bow, approaching nearest the terminal line between nerves 3 and 4—generally blends with this patch so as to appear to start from its lower edge, but is sometimes well separated from it so as to be traced further towards apex: dark space preceding subterminal line, confined between nerves 3 and 5, blending gradually with the rest of the wing, barely showing two darker sagittate spots: transverse anterior and transverse posterior either subobsolete or tolerably well defined, each by a geminate dark line: basal area divided longitudinally by an irregular dark line, the wing below it quite light-colored: orbicular spot large and elongated, a little lighter than surrounding surface, and well defined by a fulvous annulation, the pale oblique shade which generally encloses it in this genus confined to a fulvous shade above, and either a more distinct fulvous line behind or none at all: reniform spot generally dark, but sometimes lighter than space preceding; not well defined, the small pale spot at top being generally distinct, and either partaking of the same form, or resembling the small letter *c* [left wing]; the lower edge occupied by a distinct white dash, which however never extends beyond it and but seldom shows any tendency to furcate with the nerves: four tolerably distinct equidistant pale costal spots from reniform spot to apical patch: terminal line pale, even, parallel with posterior margin: terminal space dark, except near apex and anal angle, divided into subquadrate spots by the pale nerves: fringe either broad or narrow, of same color as wing, with a narrow darker inner line, relieved by two very fine paler ones which are barely distinguishable: under surface smoky, but paler inte-

* Many of the Fall Army-worms had the thoracic joints of the body more or less covered with the eggs of a *Tachina* fly, and I have bred from the worms the same parasite (*Exorista leucaniæ*, Kirk; 2d Rep. Fig. 17) which infests the true Army-worm, and still another allied species (*Tachina archippivora*) which infests the larvæ of the Archippus butterfly, and will be referred to on a future page.

riorly and terminally, and fulvous along costa; the whole with a nacreous lustre and more or less irrorate with brown, and often with a flesh-colored tint near apex; fringes dark. *Hind wings* white with a faint fulvous tint; semi-transparent and slightly irridescent, with extremities of nerves and borders, especially above, brown; fringes dusky, especially at apex, and with a paler inner line; under surface similar. Thorax, abdomen and legs of same general color as front wings, being paler below; the longer lateral and anal abdominal hairs more fulvous. Sexes with difficulty distinguished, the size and shape of the abdomen not even being a safe criterion. Maximum expanse 1.40; minimum expanse 1.05 inches. Described from 18 specimens, bred Sept. 20th—Oct. 10th, from corn-fed larvæ.

VARIETY FULVOSA, (Fig. 46, *b.*)—*Front wings* greatly suffused with fulvous, especially in the lower median space, which often inclines to ochraceous; apical space more or less defined; oblique median band distinct to median nerve, and orbicular spot with an ochre-colored centre. Described from 5 specimens, bred Sept. 25th—Oct. 3rd, from corn-fed larvæ.

VARIETY OBSCURA, (Fig. 46, *c.*)—*Front wings* of a much more uniform and darker color, either grayish-brown with a slight vinous tint, or deep smoky brown inclining to black, or a deep warm brown with but little gray; apical space either entirely obsolete or but very faintly indicated; oblique fulvous band across upper middle of wing also obsolete; the ordinary lines either entirely obsolete [one specimen only] or distinctly marked; the ordinary spots sometimes obsolete, but more generally indicated by fulvous lines. Described from 8 specimens, bred Sept. 21st—Oct. 2d, from corn-fed larvæ.

Larva, (Fig. 45, *a.*)—Ground-color very variable, generally dark and pitchy-black when young, but varying after the last moult from pale brown to pale dirty green, with more or less pink or yellow admixed—all the markings produced by fine, more or less intense, brown, crimson and yellow mottlings. Dorsum brownish with a narrow line down the middle, rendered conspicuous by a darker shade each side of it. A dark, subdorsal band one-third as wide as each joint is long; darkest at its upper edge, where it is bordered and distinctly separated from dorsum by a yellow line which, except on joint 11 where it deflects a little upwards, is quite straight; paler in the middle of each joint. A pale, either buff or flesh-colored, substigmatal band, bordered above and below by a narrow, yellow and wavy line. Venter pale. Head pale yellowish-brown, with sometimes a tinge of green or pink; the triangular piece yellowish, the Y-mark distinct and white, the cheeks with four more or less distinct lateral brown lines and with dark brown mottlings and nettings, which become confluent and form a dark curved mark at the submargin behind the prongs and each side of the stem of the Y. Stigmata large, brown, with a pale annulation, and just within the lower edge of the dark subdorsal band. Legs either light or dark. Cervical shield darker than body, with the narrow dorsal and subdorsal lines extending conspicuously through it: anal plate also dark, narrow and margined by the pale subdorsal lines—both plates furnishing stiff hairs, but without tubercles. Piliferous tubercles on joints 2 and 3, arranged in a transverse row, and quite large, especially on joint 2; on joints 4–10 inclusive the superior eight are arranged as follows: 4 in a trapezoid in dorsal space, the posterior two as far again from each other as the anterior two, and two near stigmata, one above and one behind; on joint 11 the dorsal 4 are in a square, and on joint 12 in a trapezoid, with the posterior and not the anterior ones nearest together: the thoracic joints have each a large subventral tubercle just above the legs. Length 1.10–1.50 inch. Described from numerons specimens.

Pupa.—Formed in the ground, without cocoon; of normal form, bright mahogany-brown, and with a distinct forked point at extremity.

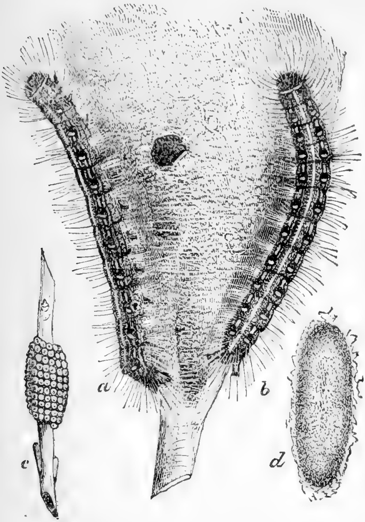
THE APPLE-TREE TENT-CATERPILLAR, OR AMERICAN LACKEY MOTH.—*Clisiocampa Americana,* Harr.

(Lepidoptera, Bombycidæ.)

What orchardist in the older States of the Union is not familiar with the white web-nests of this caterpillar? As they glisten in the rays of the spring sun, before the trees have put on their full summer

dress, these nests, which are then small, speak volumes of the negligence and slovenliness of the owner of the orchard, and tell more truly than almost anything else why it is that he fails and has bad luck with his apple crop. Wherever these nests abound one feels morally certain that the borers, the Codling-moth, and the many other enemies of the good old apple tree, mentioned in the beginning of this Report, have full play to do as they please, unmolested and unnoticed by him whom they are ruining; and when I pass through an orchard with two, three or more "tents" on every tree, I never pity the owner, because there is no insect more easily kept in check.

[Fig. 50.]



The small, bright and glistening web, if unmolested, is soon enlarged until it spreads over whole branches, and the caterpillars which were the architects, in time become moths, and lay their eggs for an increased supply of nests another year.

This insect is so well known throughout the country, and has been so well treated of by Harris and Fitch, that it is only necessary to give here the most prominent and important points in its history, the more especially as the figures alone which are given herewith will enable the novice to recognize it the moment it appears in a young orchard. Though some years quite abundant, it is not as common with us as in some of the Eastern States.

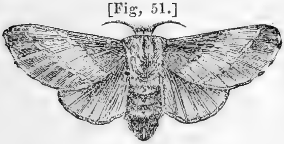
The eggs (Fig. 50, *c*) from which these caterpillars hatch are deposited mostly during the month of June, in oval rings, upon the smaller twigs, and this peculiar mode of deposition renders them conspicuous objects during the winter time, when by a little practice they can easily be distinguished from the buds, knots or swellings of the naked twigs. Each cluster consists of from two to three hundred eggs, and is covered and protected from the weather by a coating of glutinous matter, which dries into a sort of net-work. The little embryonic larvæ are fully formed in the egg by the commencement of winter, and the same temperature which causes the apple-buds to swell and burst, quickens the vital energies of these larvæ and causes them to eat their way out of their eggs. Very often they hatch during a prematurely warm spell and before there is any green leaf for

them to feed upon, but they are so tough and hardy that they can fast for many days with impunity, and the glutinous substance on the outside of their eggs furnishes good sustenance and gives them strength at first. It is even asserted by Mr. H. C. Raymond, of Council Bluffs, Iowa, that the eggs often hatch in the fall and that in these cases the larvæ withstand the severity of the winter with impunity.

The young caterpillars commence spinning the moment they are born, and indeed they never move without extending their thread wherever they go. All the individuals hatched from the same batch of eggs work together in harmony, and each performs its share of building the common tent, under which they shelter when not feeding and during inclement weather. They usually feed twice each day, namely, once in the forenoon and once in the afternoon. After feeding for five or six weeks, during which time they change their skins four times, these caterpillars acquire their full growth, when they appear as at Figure 50 (*a* side view, *b* back view) the colors being black, white, blue and rufous or reddish. They then scatter in all directions in search of some cozy and sheltered nook, such as the crevice or angle of a fence, and having finally decided on the spot, each one spins an oblong-oval yellow cocoon (Fig. 50, *d*) the silk composing which is intermixed with a yellow fluid or paste, which dries into a powder looking something like sulphur. A few individuals almost always remain and spin up in the tent, and these cocoons will be found intermixed with the black excrement long after the old tent is deserted.

Within this cocoon the caterpillar soon assumes the chrysalis state, and from it, at the end of about three weeks, the perfect insect issues as a dull yellowish-brown or reddish-brown moth (Fig. 51), characterized chiefly by the front wings being divided into three nearly equal parts by two transverse whitish, or pale yellowish lines, and by the middle space between these lines being paler than in the rest of the wing in the males, though it is more often of the same color, or even darker in the females. The species is, however, very variable.*

[Fig, 51.]



The moths do not feed, and the sole aim of their lives seems to be the perpetuation of their kind; for as soon as they have paired and each female has carefully consigned her eggs to some twig, they die,

* Dr. Fitch, in the very excellent and detailed account of this insect in his second Report, shows how very variable the moth is, and from a large series of bred and captured specimens, I can fully corroborate the fact. I have specimens which are of an almost uniform pale tawny-yellow, while others are very dark, being what might be termed a bay-brown with the pale markings conspicuous, while others have a pale band across the hind wings so conspicuous as to very closely resemble the European *neustria*. Dr. Fitch in referring to his figures must certainly have made a mistake, for he calls Figure 4 the female and Figure 3 the male, while the reverse is apparent from the figures themselves. My own figure is intended to represent the female, but the middle space of the upper wings seldom if ever appears so light in this sex, as the engraver has erroneously represented.

and when the proper time comes around again the eggs will hatch, and the same cycle of changes takes place each year.

This insect in all probability extends wherever the wild black cherry (*Cerasus serotina*) is found, as it prefers this tree to all others; and this is probably the reason why the young so often hatch out before the apple buds burst, because, as is well known, the cherry leafs out much earlier. Besides the Cherry and Apple, both wild and cultivated, the Apple-tree Tent-caterpillar will feed upon Plum, Thorn, Rose and perhaps on most plants belonging to the Rose family, though the Peach is not congenial to it, and it never attacks the Pear, upon which, according to Dr. Trimble, it will starve. It does well on Willow and Poplar and even on White Oak, according to Fitch, who also found it on Witch Hazel (*Hamamelis*) and Beech.

REMEDIES.

Cut off and burn the egg-clusters during winter, and examine the trees carefully in the spring for the nests from such clusters that may have eluded the winter search. The eggs are best cut off in the manner presently to be described for the Tent-caterpillar of the Forest. Though to kill the caterpillars numerous methods have been resorted to, such as burning, and swabbing with oil, soap-suds, lye, etc., they are all unnecessary, for the nests should not be allowed to get large, and if taken when small are most easily and effectually destroyed by going over the orchard with the fruit-ladder, and by the use of gloved hands. As the caterpillars feed about twice each day, once in the forenoon and once in the afternoon, and as they are almost always in their nests till after 9 A. M., and late in the evening, the early and late hours of the day are the best in which to perform the operation. As a means of facilitating this operation, it would be a good plan, as Dr. Fitch has suggested, to plant a few wild cherry trees in the vicinity of the orchard, and as the moths will mostly be attracted to such trees to deposit their eggs, and as a hundred clusters on a single tree are destroyed more easily than if they were scattered over a hundred trees, these trees will well repay the trouble wherever the Tent-caterpillar is known to be a grievous pest.

The chrysalids of this caterpillar are often found filled with little maggots, which produce minute Chalcididan 4-winged flies of metallic green and black colors,* and belonging to the very same genus as the celebrated Hessian-fly parasite. This parasite, with other cannibal insects, and perhaps more or less favorable seasons, tend to produce a fluctuation in the numbers of these caterpillars, so that they are more numerous some years than others, and they were more numerous in 1868 than they have been since. It has also been noticed that dry summers are injurious to them. According to Dr. LeBaron,

* Described as *Cleonymus clisiocampæ* by Dr. Fitch (Rep., vol. I, p. 200), but subsequently more properly referred to the genus *Semiotellus* (Rep., Vol. III, p. 141.

the Baltimore Oriole occasionally pecks at the nests, but does not make a common article of diet of the caterpillars, and the only birds that devour them greedily are the American Cuckoos (*Coccyzus Americanus* and *erythrophthalmus*).

THE TENT-CATERPILLAR OF THE FOREST—*Clisiocampa sylvatica*, Harr.

(Lepidoptera, Bombycidæ.)

There is another insect which in all its stages so closely resembles the Apple-tree Tent-caterpillar as to be very generally confounded with it. This insect was first described by the great Massachusetts entomologist, Dr. Harris, and very appropriately named the Tent-Caterpillar of the Forest, the better to distinguish it from the other species which is more common in our orchards. He, however, unqualifiedly states that it lives in communities under a common web or tent; but with this exception gives a very clear and truthful account of it.* It has been quite destructive in many parts of Missouri during the past two summers, and as I have had good opportunities of studying its habits I shall endeavor to dispel the confusion and uncertainty about them which have hitherto existed in the minds of most of our farmers.

ITS NATURAL HISTORY.

The egg-mass from which the Tent-caterpillar of the Forest hatches (Fig. 52, *a*, showing it after the young larvæ have escaped) may at once be distinguished from that of the common Tent-caterpillar by its being of a uniform diameter, and docked off squarely at each end. It is usually composed of about 400 eggs, the number in five masses which I counted ranging from 380 to 416. Each of the eggs composing this mass is of a cream-white color, 0.04 inch long and 0.025 inch wide, narrow and rounded at the attached end or base, gradually enlarging towards the top, where it becomes slightly smaller (Fig. 52 *d*), and abruptly terminates with a prominent circular rim on the outside, and a sunken spot in the centre (*c*). These eggs are deposited in circles, the female moth stationing herself, for this purpose, in a transverse position across the twig. With abdomen curved she gradually moves as the deposition goes on, and when one circle is com-

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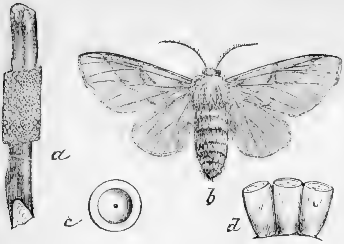
* Inj. Ins. p. 376.

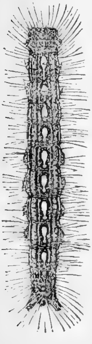
[Fig. 52.]



pleted, she commences another—and not before. With each egg is secreted a brown varnish which firmly fastens it to the twig and to its neighbor, and which, upon becoming dry, forms a carinated net-work of brown over the pale egg-shell. These eggs are so regularly laid and so closely glued to each other, and the sides are often so appressed, that the moth economizes space almost as effectually as does the Honey-bee in the formation of its hexagonal cells. In confinement the moth very seldom succeeds in forming a perfect ring, but in her abortive attempts, deposits them in different sized patches; and as I have found such unfinished patches attached to an oak leaf out-of-doors, we may conclude that either from injury or debility of some kind, the parent's instinct sometimes fails it even when all the conditions are normal and natural.

The eggs are deposited, in the latitude of St. Louis, during the latter part of June. The embryo develops during the hot summer weather, and the yet unborn larva is fully formed by the time winter comes on. The young hatch with the first warm weather in spring—generally from the middle to the last of March—and though the buds of their food-plant may not have opened at the time, and though it may freeze severely afterwards, yet these little creatures are wonderfully hardy, and can fast for three whole weeks, if need be, and withstand any amount of inclement weather. The very moment these little larvæ are born, they commence spinning a web wherever they go. At this time they are black with pale hairs, and are always found either huddled together or traveling in file along the silken paths which they form when in search of food. In about

[Fig. 53.]



two weeks from the time they commence feeding they go through their first moult, having first grown paler or of a light yellowish brown, with the extremities rather darker than the middle of the body, with the little warts which give rise to the hairs quite distinct, and a conspicuous dark interrupted line each side of the back. After the first moult, they are characterized principally by two pale yellowish subdorsal lines, which border what was before, the dark line above described. After the second moult, which takes place in about a week from the first, the characteristic pale spots on the back appear, the upper pale line becomes yellow, the lower one white, and the space between them bluish: indeed, the characters of the mature larva are from this period apparent. Very soon they undergo a third moult, after which the colors all become more distinct and fresh

the head and anal plate have a soft bluish velvety appearance, and the hairs seem more dense. After undergoing a fourth moult without material change in appearance, they acquire their full growth in about six weeks from the time of first feeding. At this time they appear as at Figure 53, and for those who are interested in such matters, I quote below Dr. Fitch's description of the full-grown larva, as it is the first accurate and detailed description that was published, and as I have occasion to refer to it further on:

"The caterpillar, as seen after it has forsaken its nest and is wandering about, is an inch and a half long and 0.20 thick. It is cylindrical and of a pale blue color, tinged low down on each side with greenish gray, and is everywhere sprinkled over with black points and dots. Along its back is a row of ten or eleven oval or diamond-shaped white spots which are similarly sprinkled with black points and dots, and are placed one on the fore part of each segment. Behind each of these spots, is a much smaller white spot, occupying the middle of each segment. The intervening space is black, which color also forms a border surrounding each of the spots, and on each side is an elevated black dot from which arises usually four long black hairs. The hind part of each segment is occupied by three crinkled and more or less interrupted pale orange-yellow lines, which are edged with black. And on each side is a continuous and somewhat broader stripe of the same yellow color, similarly edged on each of its sides with black. Lower down upon each side is a paler yellow or cream-colored stripe, the edges of which are more jagged and irregular than those of the one above it, and this stripe also is bordered with black, broadly and unevenly on its upper side and very narrowly on its lower side. The back is clothed with numerous fine fox-colored hairs, and low down on each side are numerous coarser whitish ones. On the under side is a large oval black spot on each segment except the anterior ones. The legs and prolegs are black and clothed with short whitish hairs. The head is of a dark bluish color freckled with numerous black dots and clothed with short blackish and fox-colored hairs. The second segment* or neck is edged anteriorly with cream white, which color is more broad upon the sides. The third and fourth segments have each a large black spot on each side. The instant it is immersed in spirits the blue color of this caterpillar vanishes and it becomes black.

At this stage of its growth the Tent-caterpillar of the Forest may be seen wandering singly over different trees, along roads, on the tops of fences, etc., in search of a suitable place to form its cocoon. It usually contents itself with folding a leaf or drawing several together

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* It is necessary to remark here that in the above description, Dr. Fitch reckons the head as the first segment and the first leg-bearing segment of the body, which he calls the neck, as the second segment. If Lepidopterists could be induced to adopt some uniform rule in describing larvæ, it would prevent much confusion and error.

It is astonishing how loosely these segments are referred to by most authors. Thus Dr. Fitch, after calling the head the first segment in the above description, excludes it in the descriptions of the larvæ of *Dryocampa senatoria and Dryocampa stigma* which immediately follow (Reports 3, 4 and 5, §§ 322 and 323), and speaks of the long anterior horns as proceeding from the *second* segment, whereas, to be consistent, he should have made them proceed from the *third* segment, as Mr. Wm. Saunders has done with *Dryocampa rubicunda* (*Can. Entomologist* II, p. 76). Dr. Packard (Guide etc, p. 271) speaks of the caudal horn of the larvæ of *Sphingidæ* as proceeding from the *last* segment, which it certainly does not, whichever custom be adopted. Westwood (Intr., II,) though his language on page 319 would lead one to suppose that he included the head as the first segment, more often adopts the other rule, as for instance when he refers to the 11th segment in *Mamestra*, etc., (p. 344). Burmeister in his Manual of Entomology evidently excluded the head as a segment, for he refers (p. 35) to the "three first segments of the body following the head," and afterwards (p. 41) speaks in more precise terms of the body consisting of 12 segments.

Strictly speaking, the normal insect larva is composed of 13 segments, and a more or less distinct terminal sub-segment; but in all those larvæ in which the anterior segment is covered by a horny case, so as to form a distinct head, it seems more appropriate to consider this as the head in contradistinction to the twelve articulations of the body. Especially is this the case with Lepidopterous larvæ, which are so plainly marked with a horny head, 12 soft joints and a terminal sub-joint; and this plan has been adopted by most of the leading entomologists, including Boisduval, Guenée, Harris, etc.

In my own descriptions I have always adopted this course, so that when I speak of the first joint I mean that immediately following the head. Of late I have adopted the term *joint* because it is shorter and perhaps more strictly accurate than *segment*. I also discard the term *feet*, as often applied to the horny articulate legs, for they are not feet in any sense of the word, but are the true legs of the insect, and the simple term legs or thoracic legs will at once distinguish them from the abdominal an anal prolegs or false legs.

for this purpose, though it frequently spins up under fence boards and in other sheltered situations. The cocoon is very much like that of the common Tent-caterpillar, being formed of a loose exterior covering of white silk with the hairs of the larva interwoven, and by a more compact oval inner pod that is made stiff by the meshes being filled with a thin yellowish paste from the mouth of the larva, which paste, when dried, gives the cocoon the appearance of being dusted with powdered sulphur exactly as in that of the other species. Three days after the cocoon is completed the caterpillar casts its skin for the last time and becomes a chrysalis of a reddish brown color, slightly dusted with a pale powder, and densely clothed with short pale yellow hairs, which at the blunt and rounded extremity are somewhat larger and darker. In a couple of weeks more, or during the forepart of June, the moths commence to issue, and fly about at night. This moth (Fig. 52, *b* ♀) bears a considerable resemblance to that of the Common Tent-caterpillar (Fig. 51), being of a brownish-yellow or rusty-brown, and having two oblique transverse lines across the front wings. It differs, however, in the color being paler or more yellowish, especially on the thorax; in the space between the oblique line being, even in the males, usually darker instead of lighter than that on either side; but principally in the oblique lines themselves being always dark instead of light, and in a transverse shade, often quite distinct, across the hind wings. As in *Americana*, the male is smaller than the female, with the wings shorter and cut off more squarely. Considerable variation may be found in a given number of moths, but principally in the space between the oblique lines on the front wings being either of the same shade as the rest of the wing, or in its being much darker; but as I have found these variations in different individuals of the same brood, bred either from Oak, Hickory, Apple and Rose, they evidently have nothing to do with the food-plant. The scales on the wings are very loosely attached, and rub off so readily that good specimens of the moth are seldom captured at large. So much for the natural history of our Forest Tent-caterpillar.

THE LARVA SPINS A WEB.

From the very moment it is born till after the fourth or last moult, this caterpillar spins a web and lives more or less in company; but from the fact that this web is always attached close to the branches and trunks of the trees infested, it is often overlooked, and several writers have falsely declared that it does not spin. At each successive moult all the individuals of a batch collect and huddle together upon a common web for two or three days, and during these periods —though more active than most other caterpillars in this so-called sickness—they are quite sluggish. During the last or fourth moult they very frequently come low down on the trunk of the tree, and, as in the case of the gregarious larvæ of the Hand-maid Moth (*Datana*

ministra), which often entirely denude our Black Walnuts, they unwittingly court destruction by collecting in such masses within man's reach.

IT FEEDS BOTH ON ORCHARD AND FOREST TREES.

In the summer of 1867 this insect did great damage in Western New York, where it is falsely called THE "Army-worm." From the fact that Mr. Peter Ferris, of Millville, Orleans county, N. Y., was greatly troubled with it that year in his apple orchard, and that he did not notice any of the same worms on the Oak and Walnut timber of that section, he concluded that his Apple-feeding worms must be different from those feeding on forest trees. In an article signed "F., Orleans county, N. Y.," which appeared in the *Country Gentleman* of July 23d, 1868, the same writer endeavors to prove his Apple-feeding worms distinct by sundry minute characters, as may be seen from the following extract:

Now I am not an entomologist, but still must be allowed to believe that there are several points, if not "distinctive characters," in which our caterpillar differs from the Tent-caterpillar of the Forest, as described by Dr. Fitch. His larva is of a pale blue color, tinged lower down on each side with greenish-gray. In ours the prevailing color on the back is black; there is a sky-blue stripe on each side but no greenish-gray. Both have the white spots on the back much alike, though perhaps ours are more club shaped, looking to the naked eye nearly the shape of ten-pins. Both have these spots surrounded with black; in ours there is quite a broad black stripe on each side of the spots. This black stripe is more or less filled with fine, crinkled, bright orange lines. In some, these orange lines are so plenty as to be seen plainly without the glass; in others the color to the naked eye is a fine velvet-black. In the larva described by Dr. Fitch there is much less of black and of the fine crinkled lines, which are pale orange-yellow. There is a somewhat broader stripe of the same yellow color, in place of a narrow orange one in ours. The lower yellow stripe may be much alike in both, but what is sky-blue in one is greenish-gray in the other. In both, the head is of a dark bluish color, but in his it is freckled with numerous black dots; in ours, both to the naked eye and under a glass, it is plain. In his "the second segment or neck is edged anteriorly with cream-white, which color is more broad on the sides. The third and fourth segments have each a large black spot on each side." Both the cream white edge and black spots are entirely wanting in our caterpillars.

The habits of the larvæ also appear to be different. According to Harris and Fitch, the Tent-caterpillar of the Forest lives in large societies, under a tent or cob-web-like nest placed against the side of the tree, and comes out to feed on the leaves. Others, as well as myself, have watched our caterpillars and entirely fail to discover that they lived in communities, or in any one place that they went from and returned to. While small, they remain scattered over the smaller branches and on the leaves, and are first seen to begin to get together when about half grown, on some of the higher limbs in the sun. They only collect in large bunches on the trunk and lower limbs; when nearly full grown, and the weather is hot, they get in the shade; and then they never have any web or particular place

they return to, or show any uniformity in the size of the bunches. But they only manage in this way while the leaves last. As soon as one tree is stripped they go to another, and when one orchard is used up leave for another. They are great travelers; on a smooth track, like a hard road or a fence cap-board, they get along quite fast. They do not try to keep together, but each one goes on his own hook. There is very little said about the Tent-caterpillar of the Forest traveling in this way.

Then our larvæ appear decidedly to prefer the leaves of the Apple-tree, and only feed on the leaves of other trees when the former are not to be had. Though I am not prepared to say that they will not feed on Oak, Walnut or Hickory trees, under any circumstances, I have repeatedly found these trees in full leaf when not only Apple trees, but Ash and Basswood trees near by, were entirely stripped. The eggs are sometimes laid on Hard Maple shade trees, but the caterpillars leave these trees as soon as they get much size, evidently in search of food more suitable to their taste. This may be the case in regard to Oak and Walnut trees.

They also select different places for their cocoons. Dr. Fitch says the Tent-caterpillar of the Forest selects a sheltered spot for its cocoon, such as the corner or angle formed by the meeting of two or three sides. In this the cocoon is suspended. Our larva selects one or more leaves on any tree that is convenient. The edges of the leaves are drawn together, forming a shelter in which there is generally one cocoon; though when the space is large, and they are very numerous, there are often two or three cocoons together. The cocoon is not suspended, but fastened to the leaf. They spin their cocoons in the forepart of July, and the moths appear in the latter part of the month. The Tent-caterpillar of the Forest spins its cocoon about the 20th of June, and the moth appears in the forepart of July.

Now I think enough has been given to show that two distinct insects are under consideration, but, being only a farmer, I may be mistaken. I would like to see Dr. Fitch's views on this question. Undoubtedly he has read Dr. Walsh's article on "The Three so-called Army-worms," in the *Practical Entomologist*, and can tell whether our caterpillar is a distinct insect, or only shows the variations that may be expected in the Tent-caterpillar of the Forest.

Now since Dr. Fitch has not, to my knowledge, complied with Mr. Ferris's courteous wish, the labor has devolved upon me. I have taken upwards of 200 specimens from the same batch of Oak-feeding worms, and upon critically examining them, find that Dr. Fitch's description is accurate, and that the differences or variations mentioned by Mr. Ferris arise in every case, either from a misapprehension of Dr. Fitch's meaning, or from variations which may be found in the same brood. The only real difference between the two writers lies in the statement of Dr. Fitch that the worms live under a large cob-web-like nest, and that of Mr. Ferris that they do no such thing. Both statements should have been qualified, and were made without sufficient observation; for though the normal habit of the worms is to collect outside of their nests, I have seen exceptional instances of their collecting within or underneath it, especially when young.

Now it is just barely possible that in Western New York there may be a race of these worms that has taken to feeding on Apple and

has lost all appetite or become incapacitated for feeding on forest trees; in other words, that there is a phytophagic variety, or a phytophagic species in process of formation. I could mention several similar occurrences among insects,* and to those who believe in the immutability of species these occurrences are incomprehensible enough; but to those who accept the more modern Darwinian views, and believe that species are slowly being formed to-day, just as they have been for long ages and ages in the past, they are most significant, and exactly what we should expect. But that such a race has yet been formed is rendered highly improbable from the following facts: 1st. It is spoken of both by Dr. Fitch and Dr. Harris as occurring on Oak, and by the latter as also occurring on Walnut, Apple and Cherry in the New England States. Mr. George E. Brackett of Belfast, Maine,† in referring to its ravages in the orchard, states that it also ravaged the forests in the summer of 1867, eating the leaves of most kinds of deciduous trees, though Poplar and Ash seemed to be their favorites. 2nd. I have, in our own State, successfully transferred them from Oak to Apple, and from Apple to Oak, and now have a suite of moths bred from larvæ which were fed half the time on the one and half the time on the other. Given an equal quantity of Oak, Apple, Plum, Peach, Cherry, Walnut, Hickory, Rose, they have invariably seemed to prefer and thrive best on the Apple.

IS IT EVER VERY DESTRUCTIVE?

This question is raised by Dr. Fitch, who, on insufficient grounds, discredited the previous assertion of Abbot, that it "is sometimes so plentiful in Virginia as to strip the oak trees bare." The destruction it caused in some of the Eastern States in 1866 and in 1867, is sufficient to decide this question; but there is every reason to believe that in the South and West its injuries are of still vaster extent. From Mr. John H. Evans of Des Arc, Ark., I learn that it last summer completely stripped the over-cup timber in the overflowed bottoms of that country, and for the past two years it has been quite destructive both to forest and orchard trees, in many parts of Missouri. In the Oak timber these worms prefer trees of the Black Oak group, and will seldom touch the White Oak in bodies, though when scattered among the other kinds, they attack it also.

*For an account of such insects as are known to have phytophagic varieties or phytophagic species I must refer the reader to Mr. Walsh's papers on the subject in the proceedings of the Entomological Society of Philadelphia for 1864 and 1865. But, as the most familiar and striking examples I will mention, first—the polyphagous black-pencilled larva of *Halesidota tessellata*, Sm. and Abb., found feeding on Oak, Hickory, Elm, Plum and other trees, and the monophagous orange-pencilled larva of *H. Harrisii*, Walsh, found exclusively on Sycamore; the moths from the two being absolutely undistinguishable. Second—the yellow-necked larva of *Datana ministra*, Drury, found on Apple and other trees, and the black-necked larva of the same moth found on Black-walnut and Hickory. Third—the large Butternut and Walnut-feeding form of the common Plum Curculio (*Conotrachelus nenuphar*, Herbst.)

†Amer. Journal of Hort., Sept., 1867.

ARTIFICIAL REMEDIES.

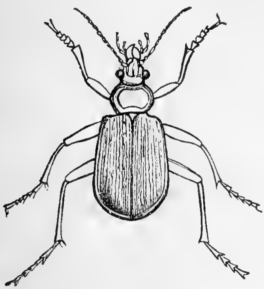
From the time they are born till after the third moult these worms will drop and suspend themselves mid-air, if the branch upon which they are feeding be suddenly jarred. Therefore when they have been allowed to multiply in an orchard this habit will suggest various modes of destroying them. Again, as already stated, they can often be slaughtered *en masse* when collected on the trunks during the last moulting period. They will more generally be found on the leeward side of the tree if the wind has been blowing in the same direction for a few days. The cocoons may also be searched for, and many of the moths caught by attracting them towards the light. But pre-eminently the most effective artificial mode of preventing this insect's injuries is to search for and destroy the egg-masses in the winter time when the trees are leafless. Not only is this course the more efficient because it is more easily pursued, and nips the evil in the bud, but for the reason that, in destroying the eggs only, we in a great measure evade killing, and consequently co-operate with, the natural parasites presently to be mentioned, which infest the worms themselves. A pair of pruning shears attached to the end of a pole, and operated by a cord, will be found very useful in clipping off the eggs; or, as recommended by Mr. Ferris, a more simple instrument may be made by fastening a piece of an old scythe to a pole. If the scythe is kept sharp, the twigs may very handily be clipped with this instrument. Tarred bandages, or any of the many remedies used to prevent the female Canker-worm from ascending trees, can only be useful with the Forest Tent-caterpillar when it is intended to temporarily protect an uninfested tree from the straggling worms which may travel from surrounding trees.

NATURAL REMEDIES.

It is always wise to co-operate, whenever we can, with our little friends among the Bugs, and it is consequently very necessary to be acquainted with them. It happens, fortunately, that we have several which aid us in keeping the Tent-caterpillar of the Forest in check, and in the natural forest we must trust entirely to these auxiliaries, as the mechanical means that can profitably be employed in a moderate sized orchard are impracticable in broad extents of timber. Indeed, these cannibals and parasites do their work so effectually that this caterpillar is seldom exceedingly numerous for more than two successive years in one locality, It prevails suddenly in great numbers, and again is scarcely noticed for years, very much as is the case with the true Army-worm. Thus, after attracting such general attention in 1867 in many parts of the East, it has scarcely been noticed since. This is its history everywhere, and we may reasonably hope that in those parts of the West where it has been cutting such a figure

the present summer, it will suddenly be so subdued as not to be noticed for some years to come. Its undue increase but combines the assaults of its enemies, until they multiply so as to gain the ascendency. Then, from insufficiency of food these enemies suddenly decrease in numbers, and their natural prey has a chance to increase again. And so it goes on in the "Struggle for Life," and in the great complicated net-work in which every animal organism is involved: a check here and a check there, and no one of all the myriad forms allowed to keep the ascendency beyond a limited time. The most efficient cannibal insects in checking the increase of this Forest Caterpillar, are the larger Ground-beetles belonging to the genus *Colosoma*. These beetles will pounce upon the worms with astonishing greed, and are especially prone to attack them when helplessly collected together during the moulting periods. The Rummaging Ground-beetle (*Colosoma scrutator*, Fabr.), which every one will recognize from the figure (54), is especially fond of them. The most common parasite which occurs abundantly in the West, as well as in the East, and which I have bred from several other caterpillars, is a maggot producing a Tachina-fly, which differs only from the Red-tailed Tachina-fly (*Exorista leucaniæ*, Kirk.), which infests the Army-worm, in lacking the red tail.* The other parasite which infests it in the East, but which I have not yet met with, is a species of *Pimpla* very closely allied to *P. melanocephala*, Brullé, but differing from that species in the head being red and not black.†

[Fig. 54.]



SUMMARY.

The Tent caterpillar of the Forest differs from the common Orchard Tent-caterpillar principally in its egg-mass being docked off squarely instead of being rounded at each end; in its larva having a row of spots along the back instead of a continuous narrow line, and in its moth having the color between the oblique lines on the front wings as dark or else darker, instead of lighter than the rest of the wing. It feeds on a variety of both forest and orchard trees; makes a web which from its being usually fastened close to the tree is often overlooked; is often very destructive, and is most easily fought in the egg state.

Exorista leucaniæ, Kirkpatrick = *E. militaris*, Walsh. I have bred the variety lacking the red at tip of abdomen from larvæ of *Attacus cecropia*, Linn., *Datana ministra*, Drury, *Agrotis inermis*, Riley, and of two undetermined Agrotidians.

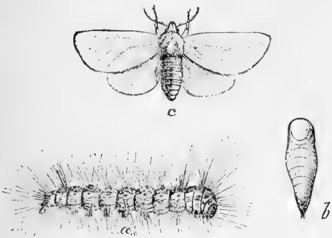
†*Practical Entomologist*, II, p. 114.

THE FALL WEB-WORM—*Hyphantria textor*, Harris.

(Lepidoptera, Arctiidæ.)

With the two preceding caterpillars is often confounded a third which in reality has nothing in common with them, except that it spins a web. The insect I refer to is known by the appropriate name of Fall Web-worm, and whenever we hear accounts of the Tent-caterpillars taking possession of trees and doing great injury in the fall of the year (and we do hear such accounts quite often), we may rest assured that the Fall Web-worm is the culprit and has been mistaken for the Tent-caterpillars, which never appear at that season of the year.

[Fig. 55.]



I do not know how injurious this insect is in the more Southern States, but he who travels in the fall of the year, with an eye to the beauties of the landscape, through any of the Northern and Middle States, especially towards the Atlantic sea-board, will find the beauty fearfully marred by the innumerable webs or nests of this worm. If they are as common as they were last fall, he will very naturally deplore the unsightly appearance of the forests, and feel amazed at the number of these signs of carelessness and slovenliness which occur in the cultivated orchards! The Web-worm is found on a great many kinds of trees, though on some more abundantly than others; but with the exception of the different grape-vines, the evergreens, the sumachs and the Ailanthus, scarcely any tree or shrub seems to come amiss to its voracious appetite. This insect passes the winter in the pupa state under ground and the moth emerges during the month of May or as late as the fore part of June. The female deposits her eggs in a cluster on a leaf, generally near the end of a branch, and these eggs hatch during the months of June, July and August, earlier or later, according to the latitude. Each worm begins spinning the moment it is born, and by their united effort they soon cover the leaf with a web, under which they feed in company, devouring only the pulpy portions of the leaf. As they increase in size they extend their web, but always remain and feed underneath it. When young the worms are pale-yellow with the hairs quite sparse and with two rows of black marks along the body and a black head. When full grown they generally appear pale-yellowish or greenish with a broad dusky stripe along the back and a yellow stripe along the sides, and they are covered with whitish hairs which spring from black and orange-yellow warts. Figure 55, *a*, gives a very good idea of a full grown worm, but the species is very variable both as to depth of coloring and markings.

Both Dr. Harris and Dr. Fitch state that this worm spins its thin cocoon in crevices of bark and similarly sheltered places above ground, but a great many of the specimens which I have reared (and I have bred specimens three different years) buried themselves and formed their cocoons just under the surface of the ground—thus giving evidence that the same insect will sometimes variously spin up above or below the ground. The chrysalis (Fig. 55, *b*) is of a very dark brown color, glabrous and polished and faintly punctured, and is characterized by swelling or bulging about the middle. The moth (Fig. 55, *c*) is white with a very slight fulvous shade: it has immaculate wings, but the front thighs are tawny-yellow and the feet blackish: in some the tawny thighs have a large black spot, while the shanks on the upper surface are rufous; in many all the thighs are tawny-yellow, while in others they have scarcely any color. One bred specimen in my cabinet even has two tolerably distinct spots on each front wing—one at base of fork on the costal nerve, and one just within the second furcation of the median nerve.

During the summer and fall of 1870 this worm was unprecedently numerous, not only in our own State but all over the country, and, as was remarked by others as well as myself, it hatched out much earlier than usual; for the first webs were noticed around St. Louis by the middle of June. It has always been supposed to be single-brooded, and in the New England States it never does perhaps produce more than one brood each year; but though such may be its normal habit, even in the latitude of St. Louis, yet there is good evidence that it sometimes produces two broods in that latitude, and in all probability does so constantly still further south. There appeared to be two broods with us the present year, and Mr. J. R. Muhleman, of Woodburn, Illinois, informed me that on August 5th, he had a second brood of worms, the first brood having appeared in June on Pear and Osage Orange. He did not, however, breed one generation from the other, and until this is done during the same year, we cannot say with absolute certainty that the species is two-brooded, for the disparity in time of appearance can be accounted for in other ways. The climate of the Central portion of our State is intermediate between that of the more Northern and the more Southern States, but the fauno partakes more of the character of the latter; and our summers are so variable in their duration and in their general intensity, that our insects show a great variability in their habits. It is for this reason that I find it very difficult to draw the rigid lines that many of our New England writers have done when treating of a particular insect, and it is for this reason that we frequently find insects, normally single-brooded there, often producing two broods a year here.

With us the Fall Web-worm appears to be most partial to the hickories and to the Black walnut, and least so to the oaks; but I have found scarcely any tree or shrub exempt from its attacks except those already mentioned, and it is even said to feed on the Hop-Plantain, Bean, Sunflower, and many other herbaceous plants.

From the foregoing account it will at once be seen how widely this Fall Web-worm really differs from the Tent-caterpillars. It hibernates in the pupa state, they in the egg state; it appears mostly in the fall, they mostly in the spring; its moth is pure white, theirs reddish brown; its eggs are deposited on a leaf, and hatch before the leaf falls, theirs are deposited around a twig, because they have to pass the winter and would get lost with the leaves if deposited upon them; it feeds solely on the parenchyma of the leaf under its web, they devour the whole leaf outside of their tent; and on account of these differences, we cannot employ the preventive measures against it which we take against them.

REMEDIES.

As, therefore, nothing can be done to materially affect this insect during the winter, we must do all the fighting when the worms first hatch. Their web soon betrays them, and the twig or branch containing it may be pruned off in the same manner described for the Tent-caterpillars. As the worms are always under the tent, the operation in this case can be performed at any time of the day without the risk of missing any wanderers.

HYPHANTRIA TEXTOR—*Larva*—(Fig. 55, *a*) Ground-color greenish-yellow. Dorsum velvety-black, with a narrow median pale line on thoracic joints. Sides speckled with black, except along subdorsal and stigmatal lines, where longitudinal yellow patches are left clear. Venter dusky or smoky-brown. Head shiny black with labrum and antennæ white. Thoracic legs black; prolegs long and narrow, smoky-black with faint orange extremities. Covered with long straight hairs, longest on joints 2, 3, 11 and 12. These hairs are either dirty white with a few black ones interspersed, or of a more uniform reddish-brown. They spring in bundles from around large warts situated as follows on each joint; 4 which are black and dorsal, arranged in a trapezoid, the anterior pair being the smaller; and four which are orange on each side, and arranged in a transverse row in the middle of the joint. Stigmata light yellow. Average length, 1.10 inches.

Varies considerably, in some the black predominating, in others the yellow. Those found on hickories are usually the darkest. When newly hatched it is pale yellow with two longitudinal rows of black marks and a black head.

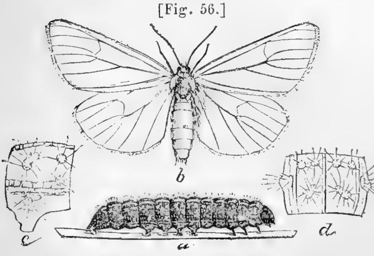
Described from numerous specimens.

THE BLUE-SPANGLED PEACH WORM—*Callimorpha fulvicosta*, Clem.

(Lepidoptera, Arctiidæ.)

In examining apple trees, but more especially peach trees, during winter or early spring, we often come across little black worms, covered with short, stiff, sprangling hairs, and studded with minute blue spots, sheltering under the loose bark. As soon as the leaves put out, these worms issue from their winter retreat and commence feeding. They

[Fig. 56.]



grow apace and by the end of April have usually acquired their full size, when they present the appearance of Figure 56, *a*; *c* showing an enlarged side section of one of the principal joints, and *d* a back view of the same. The color is now velvety black above, and pale bluish, speckled with black below; there is a deep orange line along the back, and a more distinct wavy and broken one along each side: the warts, illustrated in the enlarged sections are steel-blue and granulated, and their irregularities, as they catch and reflect the light, look like minute pale blue diamonds, the whole body, upon casually glancing at it, appearing studded with these blue points. This worm spins a slight cocoon of white silk in any sheltered place it can find, and changes to a chrysalis of a purple-brown color, finely and thinly punctured and terminating in a horizontally flattened plate, which is furnished with numerous yellowish-brown curled bristles. The moth (Fig. 56, *b*) issues from this chrysalis during the fore part of June. It is a very plainly marked species, being either milk-white or cream-colored, with the head, collar, basal and apical joints of the abdomen above, and the whole body, legs, and anterior margins of the wings fulvous or dull orange.* It was described in 1860 by Dr. Brackenridge Clemens under the name of *Hypereompa fulvicosta*† but is now properly referred to the genus *Callimorpha*. It may be known in English as the Cream Callimorpha as it is disguished from all other moths by its unspotted creamy appearance.‡ This worm is found more commonly on

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**Callimorpha vestalis*, Packard (Proc. Ent. Soc. Phil. III, p. 108), must be considered as a synonym of *fulvicosta*, for Dr. Packard has certainly given no characters that should be considered specific. To show on what grounds the new species is founded I will quote in full the original description of *fulvicosta* and afterwards that of the so-called *vestalis:*

C. fulvicosta, Clem.—"White. Palpi yellow orange, tips blackish. Head prothorax, the anterior edge of the fore wings, especially beneath, yellow-orange; sometimes the costa of the fore wings is dark brownish. Breast and legs yellow orange, the middle and fore tibiæ and tarsi blackish. Abdomen tipped with yellowish orange.
"Illinois. From Robt. Kennicott."

C. vestalis, Pack.—"♂ and ♀ pure immaculate milk-white, ♀ white. Tips of the palpi brown. Head and prothorax, basal half of the patagia and costa of both wings above and beneath yellowish. The legs are also yellow beneath. The abdomen is white and unspotted. Antennæ brown. Body ♂ .65, ♀ .65. Exp. wings ♂ 1.70, ♀ 1.70 inch.
"Middle Atlantic States (Coll. Ent. Soc. Phil., through A. R. Grote."

Now, comparing the descriptions, *vestalis* differs in no other respect from *fulvicosta*, than in the legs being yellow beneath instead of having the middle and fore tibiæ blackish as described by Clemens. Three bred specimens in my possession differ in this trifling character, and though Dr. Packard says that his species differs *remarkably* [*!!*] from the other in being pure white and of smaller size, yet Dr. Clemens gives no measurements and there are specimens in my own cabinet and in Mr. Walsh's of all shades of white to cream color and some of them fully as small as the measurements above quoted. Moreover I have a specimen marked *vestalis*, kindly sent me by my friend Cresson of the Am. Entomological Society, and while in Philadelphia last fall I examined all the specimens marked or said to be *vestalis* without finding any distinguishing characters at all. If a new species is to be made out of such trifling characters in the face of the fact that the species of the genus *Callimorpha* are very prone to vary, and that twenty times as much variation is found in hundreds of other species of Lepidoptera, what is the science of entomology to come to?

†Proc. Acad. Nat. Sci. Phil., 1860, p. 536.

‡The only insect which very closely resembles it is a pale variety of a moth known as the Egle (*Euchœtes egle*, Harr.) whose beautiful larva is tolerably common on our milkweeds. This last however may always be distinguished by the feathered antennæ of the male, the different shaped wings and the deep orange and black spotted abdomen.

the Peach than on any other tree, and as it appears very early in the season and commences to feed on the young leaves before they are fully expanded, it does considerable damage when numerous. I have been acquainted with the worm for several years past but its natural history was unknown till last summer when Dr. LeBaron and myself simultaneously bred the moth from peach-leaf feeding larvæ, so that its history is now given for the first time. Figures of the larva were given in the *Prairie Farmer* last summer by Dr. LeBaron who was misled by Dr. Hull into the belief that they were the Tent-caterpillar of the Forest already described. Two years ago I found this Blue-spangled worm tolerably common in the peach orchard of Mr. E. J. Ayres of Villa Ridge, Ills., and he says that he destroyed over a thousand of them last spring. In this State I have frequently met with it but it is by no means common. Hand picking will easily keep it in check.

CALLIMORPHA FULVICOSTA, Clem.—*Larva* (Fig. 56, *a*)—Color velvety-black above, pale bluish-gray speckled with black below. A deep orange medio-dorsal line (usually obsolete towards each end) and a more distinct, wavy, broken, yellow stigmatal line, with a less distinct coincident pale line below it. Covered with large highly polished, roughened, deep steel-blue warts, the irregularities of which as they catch and reflect the light, look like pale blue diamonds. Closely examined these warts are found to be covered with small elevations each of which furnishes a short stiff yellow hair, these hairs radiating in all directions around the warts, which are placed as follows:—Joint 1 with an anterior transverse row of 8 and a posterior dorsal row of 4; joints 2 and 3 each with a transverse row of 8 across the middle; joints 4—11 inclusive, each with 4 circular ones anteriorly, and 2 irregular ones posteriorly on dorsum (Fig. 56 *d*, each of the last evidently formed by the blending of two), and 2 on each side near the middle of joint (Fig. 56 *c*). Joint 12 with 2 that are irregular, on the back, and 1 that is circular, on each side. Anal shield formed of one large irregular wart. In addition to these there is a narrow subventral wart each side, and 2 small ventral ones on the legless joints. Head polished black with a few black hairs. Thoracic legs polished black, but pale at the joints inside: prolegs black outside, flesh-colored within and at extremities. Stigmata not perceptible. Largest in the middle of body. Average length 0.90, greatest diameter 0.15 inch.

Described from 6 peach-feeding specimens. Alcoholic specimens do not reflect the pale blue points.

The larvæ of our different *Callimorphas* seem to bear a very close resemblance to each other. I have bred *C. clymene*, Hubner, from a larva found full grown on oak (tho' whether it fed on oak I did not ascertain) which so resembled that of *fulvicosta* that I fully expected it would produce nothing else. The only difference noticeable was that it was very bright colored, with the medio-dorsal line very clear and distinct. Mr. Wm. Saunders has reared *C. LeContei* from larvæ feeding on Horse Gentian (*Triosteum perfoliatum*), and from his description of the larva* it differs principally from the above in lacking the blue reflections and in having a pale dotted subdorsal line.

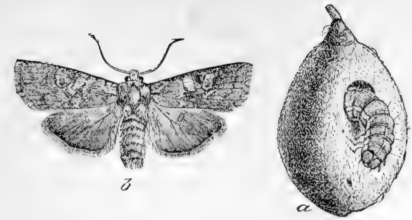
THE ASH-GRAY PINION—*Xylina cinerea*, N. sp.

(Lepidoptera, Xylinidæ).

There is a pale green worm with cream-colored spots and a broad cream-colored lateral band, which I have for several years known to

* *Canadian Entomologist* I, p. 20.

[Fig. 57.]



be common on the Apple, Poplar, Hickory and some other trees, the leaves of which it devours, but which last summer attracted unusual attention by its being frequently found boring into apples and peaches, and as I also commonly found it hiding in and feeding upon one of our large oak-apples (the *spongifica*) we may conclude that it is a very general feeder and that it is fond of boring.

This worm (Fig. 57, *a*) is found during the months of May and June and when full grown burrows beneath the surface of the ground where it forms a very thin cocoon of filmy silk with the earth adhering to it on the outside. It changes to a mahogony-brown chrysalis and generally issues as a moth during the September or October following, though in northern Illinois I have known it to remain in the chrysalis state through the winter and not issue as a moth till April.

The moth (Fig 57, *a*) varies considerably in its appearance, but is characterized by the cold ash-gray appearance of the front wings which are variegated with darker gray as in the figure. It is an undescribed species and belongs to a genus (*Xylina*) which is easily recognized by the long narrow almost rectangular wings, the very square thorax which is often furnished behind the collar with a bifid crest, and the rectangular and flattened abdomen. The wings are folded in repose and appear almost parallel and like a flattened roof—giving the insect an elongate appearance.

XYLINA CINEREA, N. Sp.—*Larva* (Fig. 57, *a*.) Length when full grown 1.20—1.30 inches, color shiny silvery-green on the back, darker below. A medio-dorsal cream-colored stripe; a subdorsal one represented by 3 or 4 irregularly shaped spots on each joint. A broad deep cream-colored stigmatal line, with a few green dints in it, extending to anal prolegs. Four slightly elevated cream-colored spots, encircled by a ring of rather darker green than the body, in the dorsal space, and in the subdorsal space there are four or more similar but smaller spots. Venter glaucous-gray. Head as large as joint 1, free, glassy-green with white mottlings at sides and top, and pearly-white lips. Thoracic legs whitish. Prolegs concolorous with venter. When young the body is darker and the markings paler.—Described from two living specimens.

Imago (Fig. 57, *b*)—*Front wings*, with the ground-color pale cinereous shaded and marked either with light brown, having a faint purplish tint, or with darker brown, having a similar reflection, or with a colder grayish-brown with the faintest moss-green reflection: in the first two cases the dark color either blends and suffuses with the ground-color so as to give the wing a nearly uniform and smooth appearance, or else contrasts sufficiently to bring out all the marks distinct; in the latter case (two specimens) the markings are very distinct and the ground color is whiter and more irrorate. In the well marked specimens the usual lines are readily distinguished, the basal half line, transverse anterior and transverse posterior being quite wavy, pale, and bordered each side with a dark shade, the median shade dark and well defined and the subterminal line, though sometimes pale near costa, forming a series of dark angular spots: in the more uniform specimens these lines are barely distinguishable and perhaps the most constant is the sub terminal which most often takes the form of a series of dark angular spots: the ordinary spots have a pale inner and a more or less distinct dark outer annulation; the orbicular is larger than the reniform and is sufficiently double to take on the form of an 8, the upper part of which is always largest and with the interior

space paler than the general surface, while that of the lower part is either concolorous or darker; the form is, however, quite irregular and differs sometimes in the two wings of the same species: the reniform spot is generally well defined, and is either darker, or has a tinge of reddish-brown, interiorly: at the base of the wing is a more or less distinct pale space occupying the upper half, and bordered below by a brown line which is straight about half its length and then extends upwards and outwards towards transverse anterior. A tolerably distinct terminal line, with the fringes dark. In taking a general view of the varying specimens this pale basal space, the pale upper part of the orbicular and the dark subterminal line, seem to be the most constant characters of the species. *Hind wings* gray-brown inclining to cinnamon-brown, with the posterior border but slightly darker and the fringe paler. Under surface quite uniform, that of front wings being nacreous gray with a faint discal spot and with a narrow costal and broad terminal border of pale fulvous, dusted with purple-gray; the hind wings of this last color with the lunule and line distinct. *Head* nearly entire, though the quadrifid arrangement of the hairs is traceable; palpi hairy throughout. *Thorax* quite square, of same color as primaries and with the collar bordered behind with brown and sometimes the edges of the tegulæ similarly bordered. *Abdomen* of same color as hind wings with lateral tufts, and cut off squarely at apex. Expanse 1.32—1.82 inches.

Described from 3 specimens fed on grape-vine, 2 on peaches and 1 on *Cercis canadensis*. Other captured specimens examined.

This species is the analogue of, and very closely resembles the European *Xylina conformis*, which is known under various synonyms. A specimen sent to Mr. P. C. Zeller of Stettin, Prussia, was, however, pronounced distinct. The well-marked irrorate form still more closely resembles Guenée's *cinerosa* found in Switzerland, and which he himself thinks may prove to be a variety of *conformis*. The more I study the species of the NOCTUIDÆ as they occur in nature, the more I am struck with their great variability, and there can be no doubt that many of the so-called species will turn out to be but varieties when we better understand them. In this large family none but the more strikingly marked species should ever be described without an accompanying description of their preparatory states and of their principal variations. I am unacquainted with any of Walker's species except *subcostalis* which is very different, and if this should prove to be a synonym of any of them, the fault must be laid to the difficulty under which the naturalist in the Western States labors for want of proper libraries to refer to. It differs essentially from Grote's *Bethunei* and *capax* as described and illustrated in Volume I of the Transactions of the American Entomological Society. I am informed by Mr. A. Lintner of Albany, N. Y., that Dr. A. Speyer of Rhoden, Furtsenthum Walldeck, Prussia, who gives much attention to the Noctuidæ, has it marked *Celæna oblonga* in his MS., but the insect evidently does not belong to that genus, and as the German pronunciation of *Xylina* much resembles the English pronunciation of *Celæna*, the reference to the latter, is doubtless due to a verbal misunderstanding.

BENEFICIAL INSECTS.

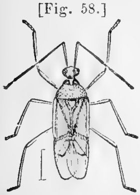
It is not often that there will be much to say in this Department, as most of the beneficial insects are treated of in connection with the injurious species upon which they prey. But the following little fellow is so important to the grape-grower that it should be recognized by every vineyardist in the State, and cherished as the very apple of his eye:

THE GLASSY-WINGED SOLDIER-BUG—*Campyloneura vitripennis,* Say.

A NEW FRIEND TO THE GRAPE-GROWER.

This is the bug; and a pretty little thing it is too! Take a good look at the figure and remember that the hair-line at the side represents the natural size.

[Fig. 58.]



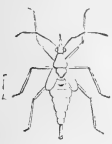
There are perhaps no insects more dreaded by the grape-grower than the different species of leaf-hoppers which sap up the substance of the leaves of the Vine; but as they will be treated of, in all probability, in my next Report, we will pass them over for the present.

No parasitic or cannibal insect has ever been known to prey upon these leaf-hoppers before, but last September, while in the vineyard of Dr. C. W. Spaulding, at Rose Hill, on the Pacific railroad, I discovered that this Glassy-winged Soldier-bug was preying upon them. The leaves were actually covered on the underside with the dead carcasses of the leaf-hoppers, which, in their death-struggle, had firmly attached themselves, and hung thickly, with wings extended and body sucked dry—dead proof of the surprising thoroughness with which their mortal foe had done its work of slaughter. On a single leaf not so large as a man's hand a half hundred of these skeleton leaf-hoppers could be counted, and though this number was above the average, there were few leaves that did not show quite a number. To use Dr. Spaulding's language, " the sight was enough to

gladden the heart of any grape-grower, who had long looked upon the leaf-hopper as a permanent evil against which he could not successfully contend."

Moving about among the leaves our little Soldier-bug* was often seen in its pretty full dress uniform, but far more commonly disguised in its larval or pupal coat; for it is only when full grown and full fledged that it presents the appearance of the first figure. The larva and pupa both have an opaque, mealy, bluish-white appearance, and the latter differs only from the former in the more conspicuous wing stubs, which project so as to give it a somewhat diamond shaped outline (Fig. 59.) It is during these immature, and less conspicuous stages that this insect doubtless does most of its work, for in common with the rest of the true Bugs (*Heteroptera*) it is active and feeds during its whole life, from the time it hatches from the egg till it dies of old age.

[Fig. 59.]



When I first saw the hosts of leaf-hoppers so mercilessly stabbed, I was at considerable loss to understand what animal could be so wary and dexterous as to surprise insects so shy and active, and with such wonderful jumping powers as the leaf-hoppers possess, and I could not rest sure that it was our little Glassy-winged Soldier-bug till I had enclosed specimens in a bottle with living leaf-hoppers, and found the latter dead next day. Like many other animals of prey, it can move actively when necessary, but no doubt prefers to surprise its victims by stealth, assisted perhaps by its colors which resemble those of the leaf-hoppers themselves.

The more common color of this insect is pale greenish-yellow. The antennæ are brown with the basal joint and sometimes part of the second joint blood-red. The head and thorax are pale yellow with a slight tinge of pink, and the eyes, neck, and front part of the thorax, except a pale line on the back, are jet black in high contrast. The scutel is pale yellow or white, and black at base, and the upper wings (hemelytra) are beautifully transparent with a rose-colored cross band and a dusky curved line. The species is a very variable one, however, being dichromous or double-colored, some varieties possessing much more brown than others, and having no rose-color at all. In a variety kindly sent me by Mr. P. R. Uhler, of Baltimore, Maryland, the antennæ are pale, and there is no black on the thorax in front, but a large brown patch behind; there is also a large brown patch each side of the scutel, and the rosy transverse band on the wings is quite brown.

Now this insect is commonly found by collectors in the fall of the year on different kinds of Oak, but no one ever heard before of its

*I have preferred to apply this popular term to this species, because its black, white and red marks, and its war-like propensities suggest something of the sort; and though the term is more strictly and correctly applied to larger cannibal bugs belonging to the genus *Arma*, yet it is not inappropriate here, and will appeal to the popular mind far more readily than the generic name *Campyloneura*, or the English rendition of it, curved-nerve.

attacking the leaf-hoppers of the Grape-vine, and it certainly could not have done so in past years to the extent that it did at Rose Hill last fall, without its work having been noticed. I have been through vineyards by the hundred in the fall of the year, and never before noticed such work. How are we then to account for its sudden appearance in such force in the vineyard of Dr. Spaulding? To my mind it is an excellent illustration of an insect acquiring a new habit. Some individual or individuals wandering from the oaks and from whatever food they there subsisted upon, came upon Dr. Spaulding's vineyard and found the leaf-hoppers of the Vine to their taste. Their food being abundant, they soon multiplied, so as to make their work appreciable, and commenced to spread from one vineyard to another. The facts in the case would support such a theory, for the bugs and their slaughtered victims were found in diminishing numbers in the vineyards in the immediate neighborhood until at the distance of three miles, no sign of either could be found. Consequently, though our little cannibal friend occurs sparingly throughout the country in the native timber, it is found in the cultivated vineyard in a limited district only, so far as we now know. But there is no reason why the field of its operations in the vineyard should not in time become co-extensive with that of the troublesome leaf-hoppers; and with our present mail facilities we can materially help to make it so by artificially introducing a few dozen of the living bugs from one vineyard to another.

This species was first described by Say as *Capsus vitripennis*. The *Phytocoridæ*, as the name indicates, have all been hitherto considered as plant-feeders, and at first the species above considered would appear to be an exception to the unity of habit in the family. But Mr. Uhler informs me that his investigations of the elongated forms of many of the recently established genera have taught him that the affinities of many of them are largely with the *Reduviidæ* through *Anthocoridæ*; for he has often found them in places where small caterpillars were numerous; among the larvæ of *Tingidæ*, and has even caught them in the act of sucking the juices of plant-lice.

INNOXIOUS INSECTS.

THE WHITE-LINED MORNING SPHINX—*Deilephila lineata*, Fabr.

(Lepidoptera, Sphingidæ.)

[Fig. 60.]

The beautiful moth which heads this chapter is quite common in the State of Missouri, and has upon several occasions been sent to me for identification. Almost every one must have been struck with the great resemblance which it bears to a humming bird, as, of a summer's evening, it flits rapidly from plant to plant in the garden, and ever and anon hovers noiselessly over some particular flower, and stretches forth its long tongue to sip the sweet nectar which that flower contains.

Few persons are, however, aware what this beautiful moth looks like, or what it feeds upon, in the caterpillar state; wherefore this brief account of it.

The very great diversity of form and habits to be found amongst the larvæ of our butterflies and moths, has much to do with the interest which attaches to the study of these masked forms. I am moved to admiration and wonder as thoroughly to-day as in early boyhood,

every time I contemplate that within each of these varied and fantastic caterpillars—these creeping and groveling "worms"—is locked up the future butterfly, or moth, which is destined, fairy-like, to ride the air on its gauzy wings, so totally unlike its former self. Verily the metamorphoses of the lower animals must prove a never-failing source of joy and felicity to those who have learned to open the pages of the great Book of Nature!

But beyond the general satisfaction experienced in studying these transient forms, there will be found ample food for the philosophic mind in the larval variations to be met with in the same species. Some vary according to the character of their food-plant, and the study of these variations—of phytophagic varieties and phytophagic species—must ever prove interesting as well as important, by throwing light on the question of the origin of species. Some (*e. g.* the common Yellow Bear, Fig. 28, *a*, p. 68) vary very much without regard to food-plant. Our Sphinx larvæ, more particularly, are subject to these variations, and it is for this reason that larval characters alone, unaccompanied by those of the perfect insect, are of so little value in classification.

The White-lined Morning Sphinx (Fig. 60) presents one of the most striking cases of larval variation, as may be seen by comparing the light form of Figure 61 with the dark form of Figure 62. In the summer of 1863 I took both these forms on the same plant, and have repeatedly met with them since; but the moths bred from them show no differences whatever.

This beautiful moth is called by Harris the White-lined Morning Sphinx, though its generic name means "Evening Friend." It is distinguished principally by its roseate under-wings, and by a broad, pale band running from the apex to the base of the dark-olive front wings.

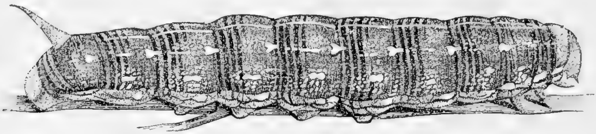
[Fig. 61.]

The larva feeds upon purslane, turnip, buckwheat, watermelon, and even apple and grape leaves, upon any of which it may be found in the month of July. It descends into the ground and, within a smooth cavity, changes into a light brown chrysalis, from which the moth emerges during the month of September.

The most common form of this larva is that given at Figure 61; its color is yellowish-green, with a prominent subdorsal row of ellip-

tical spots, each spot consisting of two curved black lines, inclosing superiorly a bright crimson space, and inferiorly a pale yellow line—the whole row of spots connected by a pale yellow stripe, edged above with black. In some specimens these eye-like spots are disconnected, and the space between the black crescents is of a uniform cream-yellow. The breathing-holes are either surrounded with black, or with black edged with yellow. The other form is black, and characterized chiefly by a yellow line along the back, and a series of pale yellow spots and darker yellow dots, as represented in the illustra-

[Fig. 62.]



tion (Fig. 62). Even this dark form is subject to great variation, some specimens entirely lacking the line along the back, and having the spots of different shape.

This insect has a wide range, as it occurs in the West Indies, Mexico and Canada, as well as throughout the United States. Feeding, as it does, principally on plants of but little value, and being very commonly attacked by the larva of a Tachina-fly, this insect has never become sufficiently common to be classed as injurious. The Tachina-fly which so commonly infests it, is readily distinguished from the other more common form by the abdomen, which is bright rufous with the exception of a broad dorsal stripe which is dark.

TWO OF OUR COMMON BUTTERFLIES.

THEIR NATURAL HISTORY; WITH SOME GENERAL REMARKS ON TRANSFORMATION AND PROTECTIVE IMITATION AS ILLUSTRATED BY THEM.

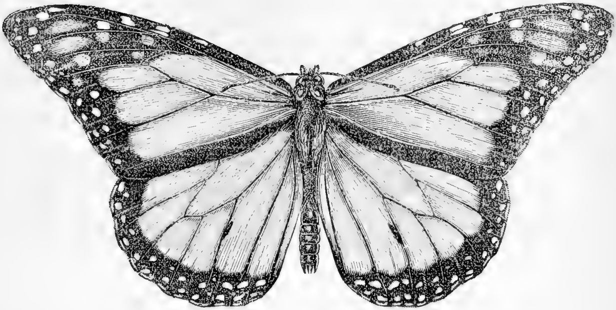
In the following pages I propose to give the complete natural history of two of our commonest butterflies, and to close with such philosophical thoughts as the subject warrants. I do so the more willingly as many of the facts are published for the first time; for notwithstanding the butterflies are so common, their complete natural history has hitherto been unknown.

THE ARCHIPPUS BUTTERFLY—*Danais archippus*,* Fabr.

(Lepidoptera, Danaidæ.)

ITS NATURAL HISTORY.

[Fig. 63.]



"What more felicitie can fall to creature
Than to enjoy delight with libertie,
And to be lord of all the workes of Nature,
To raine in th' aire from earth to highest skie,
To feed on flowres and weeds of glorious feature."
The Fate of the Butterfly—Spenser.

This beautiful butterfly, like most of the species of the family to which it belongs, enjoys a wide range, occurring in the more northern of the States and in Upper Canada and extending into South America, where, according to Mr. Bates, it is common throughout the region of the Lower Amazons.† In the Mississippi Valley it is one of our most common species. The family to which it belongs is distinguished by the front legs being spurious or abortive; by the large cell in the centre of each wing being closed, and by the existence of a small nervule originating at the base of the front wing just below the lower or sub-median nerve, and joining that nerve a short distance from its base.‡ This nervule is so covered with scales that it is hardly visible till they are removed. In the genus *Danais* the sexes are readily distinguished by the male having a small horny

* Some late writers use the specific name *erippus* of Cramer, because it seems to have the priority. I have not all the works of the old authors to refer to, but Mr. Sanborn, of Boston, has been kind enough to refer to them for me, and he writes that *erippus* was first applied by Cramer to the ♀ in 1775, and *plexippus* to the ♂ by the same author in 1780. Fabricius published his name of *archippus* in 1793, and the name had already been applied by Cramer to the Disippus butterfly. Accordingly Cramer's *erippus* has the priority; but as this insect has been very generally known by the name which Fabricius gave it, among entomological writers, and as it has become familiar to the popular ear, I prefer to retain it—especially since it is no longer applied to the Disippus butterfly.

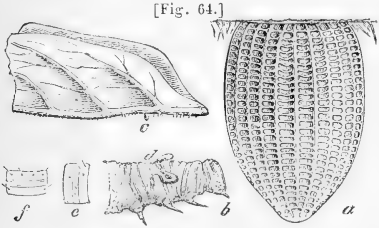
†Trans. Linnæan Soc., Vol. XXIII, p. 516.

‡Mr. Bates in a note to the paper already referred to, (p. 497,) gives this as a constant and excellent character discovered by Dr. C. Felder, of Vienna, and describes it as "a small nervule at the base of the fore-wing median nervure which anastomoses with the median a short distance from ts origin." I have no means of referring to Dr. Felder's original article, and cannot say whether e is correctly quoted; but in the two N. A. species of the genus (*D. archippus* and *berenice*) this hervule originates below and anastomoses with sub-median nerve.

excrescence near the disk of the hind wing, close to, or upon the fourth nerve. This excrescence or tubercle is faintly shown in the above figure, which represents the male, and it is entirely lacking in the female. The color of the Archippus butterfly is of a bright orange-red, marked with black and cream-color as in the figure—the underside being similarly marked but paler, that of the hind wings being bright fulvous. The species feeds upon most of the different kinds of Milk-weed or Silk-weed (*Asclepias*), and also upon Dogbane (*Apocynum*), according to some authors. It shows a wonderful dislike, however, to the Poke Milk-weed (*Asclepias phytolaccoides*), and I was surprised to find that larvæ furnished with this plant would wander about their breeding cages day after day, and would eventually die rather than touch it, though they would eagerly commence devouring the leaves of either *A. tuberosa*, *curassavica*, *cornuti* or *purpurascens* as soon as offered to them.

The butterflies hibernate, though whether any but the impregnated females survive until the Milk-weeds commence to grow is not definitely ascertained. They commence depositing eggs in the latitude of St. Louis during the fore part of May. Some of the earliest developed butterflies from these eggs begin to appear about the middle of June and others continue to appear for several weeks. These lay eggs again, and the butterflies abound a second time in October. Thus there are two broods each year, and though the first brood of larvæ are hatched more uniformly and within a more limited time than the second, the two broods yet connect by late individuals of the first and early individuals of the second, and the caterpillars may be found at almost any time from May to October, but are especially abundant during late summer and early fall.

[Fig. 64.]



The egg (Fig. 64, *a*, magnified; *c*, natural size) is invariably deposited on the under side of a leaf, and is conical and delicately reticulate with longitudinal ribs, and fine transverse striæ. It is yellowish when first deposited but becomes gray as the embryo within develops.

DESCRIPTION OF EGG.—Length 0.05; greatest diameter 0.03 inches. Conical, slightly narrower at base than in middle, and generally slightly contracted towards apex. Color pale cream-yellow; opaque, smooth; the shell but slightly polished and rather soft. About 22 longitudinal narrow carinate ribs, usually regular and single, though occasionally one gives forth a branch; interstices crossed by about 30 very fine transverse striæ, often subobsolete. Apex smooth. Slightly and singly attached to the underside of leaf.

Described from numerous specimens.

It is a little singular that this egg has not previously been described. It is very easily found, and I had no difficulty in obtaining great numbers last summer, though I owe the first one ever obtained to the sharp eyes of Miss M. E. Murtfeldt, of Kirkwood, a lady who takes much

interest in Entomology, and is an excellent observer. It were greatly to be wished that more of our ladies would interest themselves in such studies, for we have altogether too few Madam Merians.

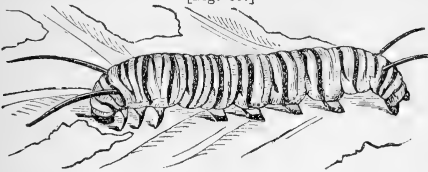
In about five days after deposition, the egg hatches, and the young larva as soon as hatched usually turns round and devours its egg-shell; a custom very prevalent with young caterpillars. At this stage it differs considerably from the mature larva; it is perfectly cylindrical, about 0.12 inch long and much of a thickness throughout. The head is jet black and polished; the color of the body is pale greenish-white with the anterior and posterior horns showing as mere black conical points, and with two transverse-oval black warts, nearer together, on the first joint. It is covered with minute black bristles, arising from still more minute warts, six on the back and placed four in a row on the anterior portion and one each side on the posterior portion of each joint, (Fig. 64, *f*); and three on each side, one in the middle of the joint, and two which are substigmatal, posteriorly, (Fig. 64, *e*.) There is a sub-triangular black spot on the anal flap, the legs are alternately black and white and the stigmata are made plainly visible by a pale shade surrounding them. When the young worm is three or four days old, a dusky band appears across the middle of each joint; and by the fifth or sixth day it spins a carpet of silk upon the leaf, and prepares for its first moult. After the first moult the anterior horns are as long as the thoracic legs, the posterior ones being somewhat shorter; the characteristic black stripes show quite distinctly, but the white and yellow stripes more faintly. After this it undergoes but slight change in appearance, except that the colors become brighter and that at each successive moult the horns become relatively longer. There are but three moults.* and the intervals between them are short, as the worms frequently acquire their full growth within three weeks from hatching.

Some persons may be curious to know how the larva acquires longer horns at each moult. The explanation is simple. During each period of growth the skin which is to serve for the next period is forming and perfecting under that which at the the time serves the worm. Upon this inner skin and beneath the outer one, the horns are also developing, and when the outer skin has become useless and the worm, after a short period of rest and fasting, bursts it near the head and works it off, the old horns go with the old skin and the new ones appear as mere stubs. The new skin is now very fresh and moist, and no sooner is the old skin off than these soft stubs begin to swell, and it is then easily seen how wonderfully the long horns

*I do not include the last moult by which the larva is transformed to the chrysalis. Some persons in counting the different moults that larvæ pass through, are content with counting the heads that are shed. Whenever this method is relied on it should be borne in mind that the heads really increase in size between each moult, though not in proportion to the increase of body. Thus, in the present species the first head is considerably larger when shed than it was when the larva hatched, and though appearing uniformly black when hatched, it shows the usual white marks more or less distinctly when shed.

have been folded up and curled over and between the wrinkles of the body so as not to impede the casting of the skin. At Figure 64, *b*, I have given a somewhat enlarged view of a worm just in the act of casting its last skin in order to show (at *d*) how the flexible horns were folded. They unbend of their own accord, though the worm often helps to straighten them out by cunningly turning its head and drawing them over the surface of the leaf.

[Fig. 65.]

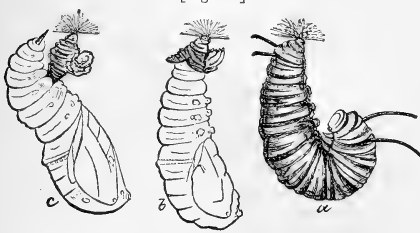


When full grown the worm presents the appearance of Figure 65, the colors being black, white and yellow.

HOW THE LARVA BECOMES A CHRYSALIS.

The metamorphoses of insects will ever prove a source of wonder and admiration. If a naturalist were to announce to the world the discovery of an animal which, for a short term of its life, existed in the form of a serpent; which then, after performing its own interment and weaving itself a shroud of pure silk, changed to something like an Egyptian mummy; and which after remaining thus buried without food or motion, for a much longer term, should at length struggle through its shroud and start into day a winged bird—every one would be interested in the history of such a marvelous creature! Yet the transformation of insects are scarcely less startling than such an occurrence would be, and it is only by drawing such a picture, that we are made to fully appreciate these changes. The methods of transformation are varied, as the reader who has perused these Reports is well aware. A good illustration is often needed in our schools, and as the present species furnishes an excellent illustration of the process in those butterflies which are suspended in the chrysalis state from the tail, and is withal so common that those who desire to witness the process will have no difficulty in doing so, I will give some account of it; for the person who had never witnessed the true method employed, might gaze a long time at the full grown larva (Fig. 65,) and the chrysalis (Fig. 67) without divining how the latter was produced by the former. We have on the one hand a crawling worm, and on the other a legless body hanging securely by

[Fig. 66.]*



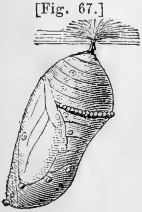
*These figures are drawn from memory and are perhaps a little ideal and inaccurate.

its tail. What has become of the larval appurtenances and how did the chrysalis attach itself? Let us see.

As soon as the larva is full grown it spins a little tuft of silk to the underside of whatever object it may be resting upon, and after entangling the hooks of its hind legs in this silk, it lets go the hold of its other legs and hangs down with the head and anterior joints of the body curved as at Figure 66, *a*. In this position it hangs for about twenty-four hours, during which the fluids of the body naturally gravitate towards the up-turned joints, until the latter become so swollen that at last, by a little effort on the part of the larva, the skin bursts along the back behind the head. Through the rent thus made the anterior portion of the pupa is protruded and by constant stretching and contracting the larval skin is slipped and crowded backwards until there is but a small shriveled mass gathered around the tail (Fig. 56, *b*). Now comes the critical period—the culminating point.

The soft and supple chrysalis, yet showing the elongate larval form with distinct traces of its prolegs, hangs heavily from the shrunken skin. From this skin it is to be extricated and firmly attached to the silk outside. It has neither legs nor arms, and we should suppose that it would inevitably fall while endeavoring to accomplish this object. But the task is performed with the utmost surety, though appearing so perilous to us. The supple and contractile joints of the abdomen are made to subserve the purpose of legs, and by suddenly grasping the shrunken larval skin between the folds of two of these joints as with a pair of pincers, the chrysalis disengages the tip of its body and hangs for a moment suspended as at Figure 66, *c*. Then with a few earnest, vigorous, jerking movements it succeeds in sticking the horny point of its tail into the silk, and firmly fastening it by means of a rasp of minute claws with which that point is furnished. Sometimes severe effort is needed before the point is properly fastened, and the chrysalis frequently has to climb by stretching the two joints above those by which it is suspended, and clinging hold of the shriveled skin further up. The moment the point is fastened the chrysalis commences, by a series of violent jerkings, and whirlings to dislodge the larval skin, after which it rests from its efforts and gradually contracts and hardens until it presents the appearance of Figure 67. The really active work lasts but a few minutes, and the insect rarely fails to go through with it successfully. The chrysalis is a beautiful object and as it hangs pendant from some old fence board or from the underside of an Asclepias leaf, it reminds one of some large ear-drop; but though the jeweller could successfully imitate the form, he might well despair of ever reproducing the clear pale green, and the ivory black and golden marks which so characterize it.

[Fig. 67.]



This chrysalis state lasts but a short time, as is the case with all those which are known to suspend themselves nakedly by the tail.

At the end of about the tenth day the dark colors of the future butterfly begin to show through the delicate and transparent skin, and suddenly this skin bursts open near the head and the new-born butterfly gradually extricates itself, and, stretching forth its legs and clambering on to some surrounding object, allows its moist, thickened and contracted wings to hang listlessly from the body. Under the direct influence of the air, the circulation quickens so that the fluids of the body are driven into every portion of these wings, and they visibly expand under the eye, while the other parts of the body gain in strength and firmness. In less than an hour, and often within half an hour, the wings are ready to perform their intended work and our gay Archippus takes his first lesson in æronautics. Ah! what an enviable fellow is he,

——Lazily flying
Over the flower-decked prairies, West;
Basking in sunshine till day-light is dying,
And resting all night on Asclepias' breast;
Joyously dancing,
Merrily prancing,
Chasing his lady-love high in the air,
Fluttering gaily,
Frolicking daily,
Free from anxiety, sorrow and care!

THE LARVA ENJOYS GREAT IMMUNITY FROM THE ATTACKS OF BIRDS AND OTHER PREDACEOUS ANIMALS.

Many of our insects, from one cause or another, enjoy a wonderful immunity from the attacks of predaceous and parasitic animals and there exists a curious relation between color and edibility. It is a very general rule that those which have such an immunity from the attacks of enemies, are conspicuously colored and feed openly upon the plants they attack; while those which are persecuted are generally of sombre and evasive colors, and often possess some protective resemblance to the objects upon which they occur, or hide themselves in one way or another. For several years past Mr. J. Jenner Weir, of London, England,—a gentleman whom I had the pleasure of meeting some eleven years ago—has made numerous experiments with the direct view of ascertaining what species of insects are eaten by birds and what species are rejected; and the results of these interesting experiments are recorded in the Transactions of the London Entomological Society (1869, pp. 21–26 and 1870 pp. 337–9). They point conclusively to the facts above given, and Mr. A. G. Butler of the British Museum made corroborating experiments, with, lizards, frogs and spiders. Prompted by these experiments made in England, I was led to make similar ones with our gaily colored Archippus larva, and the result fully accords with that obtained by Mr. Weir; for neither turkeys, chickens, toads or snakes would touch it. The reason why predaceous animals refuse these gaily colored larvæ is not always

so easy to explain, but in the present case it is undoubtedly owing to an odor which the larva possesses. This odor is hardly appreciable, when the larvæ are in the open air; but by confining a few of them for a short time in a tight box, it soon becomes apparent, and is pungent and nauseous in the extreme even to our sense of smell, and it is doubtless more intensely so to the keener sense of birds and other animals.

Mr. A. R. Wallace believes that the gay colors of such larvæ are really protective, because if by more sombre colors they were undistinguishable from edible species, they would be seized by birds, and though rejected afterwards, would be so much injured that the probability of their producing butterflies would be very remote, even if they were not killed outright.

The same immunity is enjoyed by our Archippus butterfly in all its stages, and especially in the perfect state, in which the peculiar odor is still stronger, as I have abundantly proved.

The larva does not however enjoy entire immunity from parasites as has been hitherto supposed, for though after extensive experience I have never found any of the numerous Hymenopterous parasites attacking it, it is nevertheless often killed by a Dipterous Tachina-fly. I have never noticed any such parasite in the first brood of larvæ, but last year in the immediate vicinity of St. Louis, not one in fifty of the second brood escaped its fatal work; and this same parasite was by no means confined to one locality, as I received it from Mr. S. S. Rathvon, of Lancaster, Pa., who found the Archippus larvæ and chrysalids badly infested. The eggs of the Tachina-fly must be deposited for the most part while the larvæ are young, for specimens of larvæ taken at the first moult and confined in cages where no flies could get access to them, were frequently parasitised. These victimized larvæ usually succumb a day or two before they are full grown, though occasionally one succeeds in effecting the change to the chrysalis. They grow sickly and, hanging by the hind legs, become flaccid and discolored, while the parasitic maggots pierce the skin and fall to the ground, which they enter to transform. A silky liquid escapes from the breathing pores and from the holes made by these maggots, which, when dry, forms long white semi-elastic threads; and as the discolored larvæ hang by hundreds from the milkweeds, with these glistening filaments, one might at first imagine they had been smitten with some epidemic disease.

The Tachina maggot is not specially distinguishable from the many other larvæ of this kind which are known to infest the bodies of other insects, but the spiracles are encircled by a very distinct dark brown ring.*

* The larva of this Tachina-fly, after it enters the ground, contracts very rapidly to the pupa state, and if retained on a hard surface, one may watch with interest how, as the chitinous covering thickens and hardens, the dark head is vigorously kept at work underneath it, gnawing or abrading the thickening skin in a constant circle, so as to partially sever that portion which serves as a lid to be easily pushed open by the future fly. I have often wondered how this lid in so many

Our Tachina-flies generally very closely resemble each other, and very little attention has been paid to them in this country. The present species seems to be new to science, but I forbear to describe it for the simple reason that it varies so much in itself and so closely resembles many others, that it would be next to impossible to characterize it sufficiently. It may be provisionally known, for purposes of reference, as the Archippus Tachina-fly—*Tachina* archippivora*. It may be at once distinguished from the two flies described in my second Report (p. 51), and which attack the true Army-worm, not only by the different form and smaller size, but by being of a paler gray, and by lacking the reddish or yellowish tail. The eyes are perfectly smooth. An interesting fact connected with this fly is that it likewise attacked the Fall Army-worm (as already mentioned on page 116, note,) which was so abundant at the same time of year. I have also bred it undescribed cut-worm.

The *Tachinariæ* can only be satisfactorily studied in connection with their habits, and even then they must prove a most difficult Division to work up. The species are very apt to grease in the cabinet and where they do not grease, the colors, especially of the face, lose their brilliancy. I am satisfied that the same species often attacks indifferently many widely distinct larvæ and that there are, in consequence, entomophagic varieties. I have a score of different lots, bred from as many distinct species of Lepidopterous and even Coleopterous larvæ; and the individuals of each lot, often bred from a solitary specimen of some particular species of larva, differ more among themselves than from individuals of some other lot, bred from a distinct species of larva. Indeed, unless there are striking characters, it would be folly for any but the specialist to attempt to describe them. These Tachina-flies, indeed, form such an extensive Division that in order to facilitate study, authors have inclined to erect genera upon characters most trivial and such as would certainly not be looked upon as of more than specific value in other groups. Sixteen specimens bred from *Danais archippus* vary from 0.18—0.30 inch in length and from 0.33—0.60 inch in expanse: some have a rufous spot on the side of the second abdominal joint, while others show no signs of any such spot. From among them two somewhat distinct forms occur in about equal numbers. In the one, which is on an average the largest, the abdomen is rather broader, and when dry shrinks so as to become flat, while the antennæ have the third joint from four to five times as long as the second. In the other the abdomen is rather narrower, remains more cylindrical when dry, and the antennæ have the third joint from five to six times as long as the second. These differences are, I believe, sufficient to cause the specialist to make distinct species or even genera; but as the same two forms occur in those bred from other species of larvæ, and as all the other

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coarctate pupæ was so regularly and smoothly opened by the nascent fly; but am now satisfied from observations made on this particular species, that it is previously prepared by the larva while contracting, in the manner described above. This will be more especially the case where the contracted skin is thick as in *Cuterebra*, *Œstrus*, etc., while in those where the skin is thin and delicate as in *Anthomyia* and many of the smaller *Muscidæ*, the habit probably does not obtain, as the fly can crowd itself out, and the opening is quite irregular, sometimes transverse, at others forming a simple longitudinal slit. I have witnessed the same wonderful forethought in the larva of *Chrysopa*, after spinning its small cocoon. In this case the sharp sickle-like jaws of the larva enable it to cut very finely and smoothly, and the edge of the severed parts show plainly, under the lens, a slight discoloration. The circle inscribed is often, but not always, slightly spiral so that when pushed open the lid hangs as on a hinge. The same habit no doubt prevails in the Lepidopterous genus *Limacodes* and its allies; for I have experimentally proved, by opening several cocoons of *Callochlora viridis*, Reakirt, both while the inmate was yet in the larva or pupa state, that the lid opens with the slightest pressure, and just as regularly as if pushed from within. There is, however, a marked difference in the working in these last two cases and that of our Dipterous larvæ. The former enclose themselves in cocoons, in which they have abundant room to turn round and partially cut their lid, while the Tachina larva performs the work on its own skin while it is hardening and before it has become separated from the transforming body within.

* I forwarded specimens of this fly to Dr. LeBaron, the State Entomologist of Illinois, who is better posted as to the minute generic differences between these flies, than any one else in the West, and he refers it to the genus *Masicera*, Macq., in speaking of which Macquart says: "they are the only *Tachinæ* which have the third joint of the antennæ very long without at the same time having the front very prominent." This and other minor genera of Macquart and Meigen have been discarded by some modern authors, such as Walker and Zetterstedt, and referred to *Tachina*.

details of structure, coloration, etc. are precisely similar, and as these differences themselves graduate, I cannot consider them specific. I have bred the same fly from larvæ of *Prodenia autumnalis* as stated above; also from larvæ of an undescribed Noctuan, closely resembling *Agrotis subgothica*, Haw. These specimens differ only in the rather smaller average size and more slender body, from specimens bred from several other distinct larvæ, and from the pupa of *Cynthia cardui*. It is also an interesting fact that the largest specimens of what appear to be but one species are those bred from the largest larvæ, as for instance that of *Citheronia regalis*.

THE BUTTERFLY OFTEN CONGREGATES IN IMMENSE SWARMS OR BEVIES.

Various butterflies have long been known in Europe, to swarm prodigiously at certain periods; but in this country no other butterfly congregates in such swarms as our Archippus, though the Painted Lady (*Cnythia cardui*), an insect found in all four quarters of the globe, and often seen in swarms in Europe, has been known also to swarm in Canada.

The Archippus butterfly appears in large bevies or flocks almost every year in some part or other of the West. In September, 1868, I received accounts of their sudden appearance in different parts of the city of Madison, Wisconsin, and at Manteno, Ills.; while on the 19th of that month Mr. P. B. Sibley of St. Joseph, Mo., sent me specimens with the statement that he saw millions of them filling the air to the height of three or four hundred feet, for several hours flying from north to south, and quite as numerous as the grasshoppers had been the year before.

In the spring of 1870 I received the following account of such a swarm from L. J. Stroop of Waxahachie, Ellis Co., Texas:

During my ramble this morning (March 31st) I happened upon a flock or bevy of butterflies known as *Danais archippus*, Fabr., containing thirty individuals, four of which I captured for the purpose of identification, only two of which, however, I pinned down. I find them to be of the genuine *archippus*, identical in every respect with specimens bred from the caterpillar by myself last summer, except in that of color, which is somewhat paler in these captured this morning than it was in those bred by me in the summer. They have the appearance of having been on the wing some days.

A little later the same spring similar swarms were noticed in different parts of Kansas, the most remarkable of which was one which occurred at Manhattan about the middle of April, and which, as I learn from Mr. Thos. Wells of that place, came rapidly with a strong wind from the N. W. and filled the atmosphere all around for more than an hour, sometimes so as to eclipse the light. Again, large flocks passed over the same place in a southerly direction, on the evening of the 27th and morning of the 28th September, while at Alton, Illinois, great numbers of them were seen passing in a S. W. direction on the last day of October of the same year.

It would be difficult to give any satisfactory reason for this assembling together of such immense swarms of butterflies. Insects otherwise solitary in their habits sometimes congregate thus for purposes of emigration; but this can hardly be the object of our butter-

fly bevies. They certainly do not travel very long distances or we should hear more numerous accounts of them. There are two significant facts connected with them from which some corollary might be deduced, namely, that only those species which have a very extended range are known to form such flocks, and that they always travel, under these conditions, in a southerly or south-westerly direction. Mr. Bates* gives an interesting account of the uninterrupted processions of butterflies belonging to the genus *Callidryas*, which passed from morning to night in a southerly direction across the Amazons; and as far as he could ascertain these migrating hordes were composed entirely of males.

If our Archippus flocks should turn out to be all males, this fact may lead to some solution of the cause of their congregating; but I incline to believe the flocks are composed of both sexes. Again, if the swarms occurred during the egg-depositing season, we might even then venture to solve the problem. For it is evident that a species which enjoys such immunity from predaceous animals and which is confined in its diet to a single family of plants, must occasionally multiply in particular districts beyond the capability of the plants to sustain them; and as most female butterflies instinctively refuse to deposit eggs on a plant that has already been abundantly supplied by some other individual, the females of our Archippus would naturally roam in vain for fresh plants when once the latter had all been stocked; and would thus congregate together, and, followed by the males, form migrating bevies. Or we might suppose that after the larvæ had eaten up all the milk-weeds in a district, the butterflies they produced, finding no plants upon which to lay their eggs, would be forced to migrate in swarms. But neither of these suppositions can have much weight from the fact that the swarms occur either late in the fall or early in spring; and the most plausible solution under the circumstances is that, as these are the seasons when the milk-weeds are either destroyed or have not yet started to grow, the butterflies, having nothing to confine their attention and keep them isolated, naturally congregate together, and that when in motion, the low temperature of the seasons instinctively prompts them to wend their way southwards. The probabilities are that these swarms are eventually destroyed, for no species can multiply beyond a certain limit, and when there is not check to increase in one direction, there will be in another. Of course this is as yet all theory and hypothesis, but hypotheses in such cases are necessary, for they are threads on which to string and combine the known parts of a case so as ultimately to arrive at the real truth in the matter.

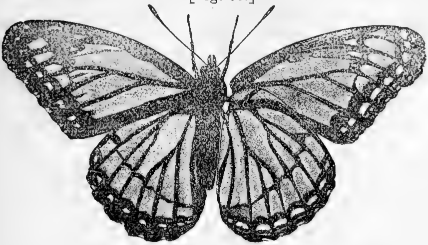
* Naturalist on the River Amazons, I, p. 249.

THE DISIPPUS BUTTERFLY—*Limenitis disippus*, Godt.

(Lepidoptera, Nymphalidæ).

This is another butterfly (Fig. 68) which is well known in the Mississippi Valley. It belongs to a family which agrees with that to which the previous insect belongs, in the front pair of legs being more or less functionally impotent, but differs remarkably from it in the large cell in the centre of each wing never being closed externally by a distinct tubular vein, and in its being generally open towards the outer margin of the wing: also in lacking the small nervule at the base of the front wing, spoken of on page 143.

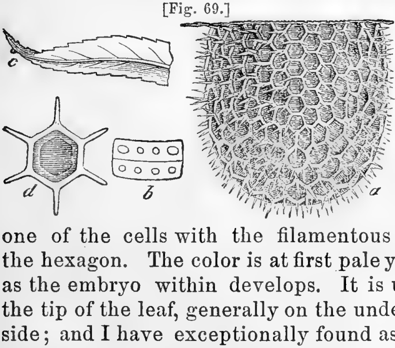
[Fig. 68.]



The food-plants of the Disippus butterfly are Willow, Poplar and Plum, and though not as numerous as the Archippus, it is yet tolerably common in the Mississippi Valley and occurs sparingly all over the United States and in the West Indies. As will be seen by referring to the figure*, though belonging to an entirely distinct family, it nevertheless bears a great general resemblance to the Archippus butterfly, and this resemblance is rendered more striking by the colors of the two insects being identically the same.

The natural history of this species is fully as interesting as that of the Archippus butterfly—if not more so. The egg which, so far as I am aware, has never before been described and figured, differs remarkably from that of the Archippus butterfly and is well represented at Figure 69, *a* showing it greatly magnified, *c* of the natural size and *d* giving a greatly magnified view of one of the cells with the filamentous processes from each angle of the hexagon. The color is at first pale yellow but soon becomes gray as the embryo within develops. It is usually deposited singly near the tip of the leaf, generally on the underside but often on the upper side; and I have exceptionally found as many as three together, and sometimes one on either side of the leaf, opposed to each other.

[Fig. 69.]

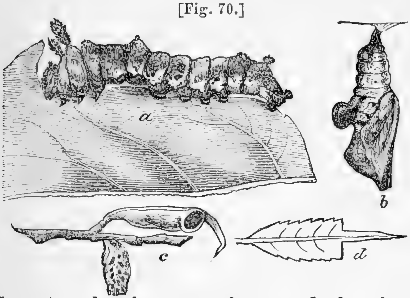


* In Figure 68, which represents the Disippus butterfly, the left wings represent the upper surface, and the right wings, which are detached from the body, represent the lower surface. The difference in the coloration of the two surfaces is but slight in this species, neither does it amount to much in the Archippus butterfly; but in some butterflies and in others belonging to the same genus, it is very considerable.

DESCRIPTION OF THE EGG.—Length 0.38 inch. Diameter at base about the same. Globular, with the top often slightly depressed. Hexagonally reticulate, the cells more or less regular, sunken so as to give the egg a thimble-like, pitted appearance, and about 10 of them in the longitudinal row and 30 in the circumference. Covered with translucent filamentous spines, one arising from every reticulate angle and giving the egg a pubescent appearance. Each spine about as long as the cell is wide, those on the top being longest.

The young larva differs materially from its more mature self, as will be seen from the description which follows. It grows apace, casting off its old coat and devouring the same three times during its growth, and eventually suspending itself by the hind legs and transforming to the chrysalis, frequently within a month from the time of

[Fig. 70.]



hatching. The mature larva (Fig. 70, *a*) presents a roughened tubercled appearance and varies much in color, the predominan colors being moss-green, brown and creamy-white; the moss-green parts being studded with beautiful light blue points. The pupa Fig. 70, *b*) is marked with burnt-umber brown, ash-gray, flesh-color and silvery white, and is characterized like that of the other species of the genus, by a curious thin almost circular projection which has been likened to a Roman nose, growing out of the middle of its back.

DESCRIPTION OF MATURE LARVA.—Length 1.20, diameter 0.25 inch. General color either whitish or olive-green. Body thickly granulated. Head dull olive, with dense minute prickles; its vertex bifid and terminating in a pair of prickly cylindrical horns, transversely arranged and each about 0.03 inch long. Back speckled and mottled with olive of different shades above the line of the spiracles, except joints 2 and 8 and the upper part of 7 and 9, but with a continuous pure white line below the spiracles, beneath which white line on joints 4–10 is a large olive patch extending on joints 6–9 to the external tip of the prolegs. A pair of black transversely-arranged dorsal dots in the suture behind joint 2, and a more or less obvious lateral one just above and behind the 5th and 7th pair of stigmata surmounting the lateral white line. Joints 3–7 and 9–11 with more or less, shining, elevated, blue dots. On joint 2 a pair of prickly cylindrical black horns, transversely arranged and 0.16 inch long. On joints 3, 10 and 11 a pair of large dorsal tubercles transversely arranged, each crowned by a little bunch of 8–12 robust prickles. On joint 5 a pair of similar tubercles, but still larger, of a yellowish color, and mamma-like. On joints 4, 6, 7 and 9 tubercles similar to those on joints 3, 10 and 11, but smaller. On joint 12 four black prickly dorsal horns, quadrangularly arranged and each about 0.03 inch long. Stigmata and legs blackish.

Described from many specimens. Such are the prominent and more constant traits of this larva, but it is so variable in the general depth of coloring and in the proportion of the lighter and darker shades that it is next to impossible to frame a description which shall alike agree with half a dozen specimens.

The newly hatched larva presents a quite different appearance. It is 0.09 inch long with a yellowish-brown head twice as large as the first joint and distinctly bilobed. The first joint is also larger than the others. Each joint is divided by a transverse impressed line, and upon the dorsum of each fold thus made are 4 pale elevated spots, the anterior outer ones larger than the rest, as shown at Fig. 69, *b*, especially on joints 2, 3, 5 and 11 where they appear conical with a darker annulation at base. There is a subdorsal and a sub-stigmatal row of similar rounded warts, and they all give rise to little pale bristles or spines. The general color is pale yellowish-brown, mottled with dark streaks, especially below the stigmata. The second period scarcely differs from the first

except in the somewhat greater length of the horns. In the third period the horns acquire their mature proportions, and the whole larva becomes more granulated. In the fourth or last the blue points appear and the lateral rows of tubercles lose their conspicuousness to a great extent.

ITS WINTER QUARTERS.

One of the most interesting features in the life-history of our Disippus butterfly is its mode of hibernating. A great many moth larvæ pass the winter in the larva state sheltered in one way or another; but no other American butterfly has hitherto been recorded as hibernating in this state, except the closely related Ursula butterfly,* though no doubt the few other species belonging to the same genus possess a similar habit. Misled, perhaps, by the fact that the butterfly is seen flying about so early in the spring that it could not have had sufficient time to hatch out from the egg and acquire its full larval growth the same season, and with its wings so bright and unworn that it could not have hibernated as a butterfly as some other closely allied species are known to do; Dr. Harris, in his work on Injurious Insects (p. 282) asserts that it hibernates in the pupa state, though he subsequently, in the year 1850, became aware of the facts in the case.†

In reality the larvæ of the autumnal brood, when about one-fourth or one-third grown, build for themselves curious little houses (Fig. 70, *c*), in which they pass the winter. First and foremost—with wise forethought, and being well aware through its natural instincts, that the leaf which it has selected for its house will fall to the ground when the cold weather sets in, unless it takes measures to prevent this—the larva fastens the stem of the leaf with silken cables securely to the twig from which it grows. It then gnaws off the blade of the leaf at its tip end, leaving little else but the mid-rib, as shown in Figure 70, *d*. Finally, it rolls the remaining part of the blade of the leaf into a cylinder, sewing the edges together with silk.‡ The basal portion of the cylinder is of course tapered to a point, as the edges of the leaf are merely drawn together, not overlapped; and invariably the lower side of the leaf forms the outside of the house, so as to have its projecting mid-rib out of the way of the larva, as it reposes snugly in the inside. The whole when finished (Fig. 70, *c*) has somewhat the appearance of the leaf of a miniature pitcher-plant (*Sarracenia*), its length being 0.50–0.65 inch, and its diameter 0.11–0.14 inch.

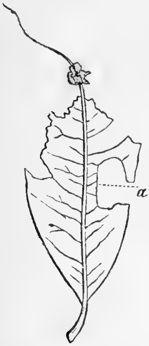
*There is good reason to believe, however, that some of those butterfly larvæ which habitually protect themselves by a sort of loose cocoon, made by drawing together or rolling up the leaves of their food-plant; likewise pass the winter in the larval state. At least I have known an oak-feeding larva of *Nisoniades juvenalis*, Sm. and Abb., kept by a lady friend of mine, to remain in the larva state nearly all winter before transforming to the chrysalis. But there is not strict analogy between such a case and that of the hibernation of the immature *Disippus*.

† *Harris Correspondence*, p. 245.

‡ In the article in the *Am. Entomologist*—which was the greater part of it written by Mr. Walsh, with my own facts and experience inserted here and there—it is stated that the "gnawed portion of the leaf forming the flap, is bent down and fastened by silken cords, so as to act as a door to the house." After fuller experience, I find that this is very seldom the case, but that the orifice is more often left open.

These curious little cases may be commonly found upon our willows or poplars in the winter time. I have examined hundreds of them, and although they are invariably built upon the same plan, they vary greatly in the degree of perfection which the architect attained; and this is especially the case when they have been built in confinement. The blade on the tip piece is sometimes gnawed off right down to the rib; at others it is left almost as broad as the tube. Sometimes it is bent over the orifice; at others not. They are also much more irregular and ungainly when made from broad leaves such as those of the Silver poplar, than when made from the more narrow leaves of the Willow. These autumnal larvæ have also another peculiar habit not heretofore recorded, and which was first pointed out to me by Mr. J. A. Lintner, of Albany, N. Y. They exhibit a tendency to build from the time they are born, and will always eat the leaves from the side, gnawing large holes and cutting along the sides of the mid-rib, as at Fgure 71, *a*. They commence at the tip and as they work downwards towards the base, they collect the debris into a little bunch, which they fasten with silk to the mid-rib. When the hibernaculum is finished the seam is perfectly smooth and the whole inside is lined with silk. The larva, after completing its work, composes itself for the winter, with the tail towards the orifice. Here it remains till the catkins are in bloom the next spring, when it retreats from its house and commences feeding. Not the least wonderful part of the phenomenon is, that it is only the autumnal brood of larvæ that form pitcher-like houses to live in during the inclement season of the year, the summer brood having no occasion to shelter themselves from the cold. We thus have an instance of a curious architectural instinct being only developed in alternate generations; which is much the same thing as if, with a certain race of men, the great-grandfathers, the fathers and the grandchildren ran wild in the woods, and the grandfathers, the sons and the great-grandchildren lived in houses and led the life of civilized human beings.

[Fig. 71.]



When we duly consider this peculiarity in our Disippus larva, we may well pause and ask—

What wondrous power enables it so well,
The coming cold of winter to foretell,
And to provide for its long torpid rest,
A house, from means at hand, the very best?

We can but admire the beautiful adaptation of means to an end—no matter how we choose to explain it! There can be little doubt but that many of the phenomena in animal life which we so summarily dispose of by the ready use of that rather blind term "instinct,"

might be explained in a more natural way. The term is justly applied to those actions which are prompted by exterior influences or peculiarity of organization, and which are performed unconsciously; but by its too general application, most people have acquired a deep-set idea that all animals act under its power, and have nothing akin to our reason; whereas there is hardly anything more certain than that true reason of degree exists very generally in the animal kingdom; or that what we know as pure instinct may have been developed by natural law, *i. e.*, first acquired by experience and afterwards fixed as a habit by heredity.

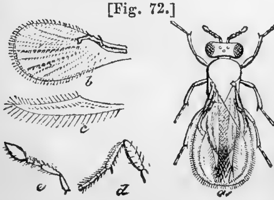
The subtle influences of the late fall which seem to convey through every pulse of nature, intelligence of the approaching winter, and which cause all animals to prepare for their hyperborean sleep, no doubt originally induced the young larva of the ancestral type from which our Disippus and the other species of the genus sprung, to prepare for itself some shelter. The gradually increasing cold and the decrease of nourishment in the leaf, would act as physical prompters, and the pitcher-like house, which at first strikes us as so remarkable, is the simplest structure that could be made with the materials at command. The characteristic smoothness of its food-plant—forbidding as it does the shelter under loose bark which many larvæ seek—would also tend to develop such a trait. That this trait—this instinct—should only be developed under similar conditions to those which gave birth to it, is not so remarkable; and that it does only so develop, seems certain, for I have every reason to believe that while the insect is two-brooded further north, it is sometimes three-brooded with us, and consequently that this peculiar instinct obtains either in the second or third generation, according to circumstances.

ITS PARASITES.

Though not generally known to entomologists, our Disippus butterfly is very subject to the attacks of parasites, at least three distinct species infesting it in the preparatory states. One of these is a *Tachina*-fly, of which I have often noticed the eggs fastened transversely on the back of the neck of the larva, but of which I have not obtained the fly. In all probability it does not destroy the larva till the latter is nearly full grown. The other two I will briefly describe as no mention has heretofore been made of them.

THE DISIPPUS EGG-PARASITE.—The eggs already described were very abundant last fall on a certain clump of willows near Kirkwood, and of about two hundred obtained, fully one-half of them were parasitised. Instead of hatching out into larvæ, as they would have done if they had been unmolested, these last produced little dark-colored four-winged flies, from four to six of which

[Fig. 72.]

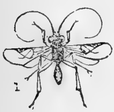


would gnaw their way through the shell of each egg. This little fly belongs to the great *Chalcis* family, and though scarcely more than 0.02 inch long, it can jump to the distance of several inches. Its wings, especially the hind ones, are beautifully fringed with hairs. It is inconspicuously marked, the body being dark brown with the antennæ and legs pale, and the wings iridescent. The highly magnified outlines at Figure 72 will convey a good idea of its appearance, *a* showing the fly with wings folded on the back, *b* one of the front wings, *c* one of the hind wings, *d* one of the legs, and *e* one of the antennæ.

I shall leave the proper determination of this insect to those who pay more particular attention to the CHALCIDIDÆ. It comes nearest the genus *Trichogramma,* Westw., and may be provisionally called *Trichogramma* (?) *minuta.* It differs from that genus and from all other Chalcididan genera with which I am acquainted, in the antennæ being but 5-jointed (scape, plus 4 joints), the scape stout and as long, or longer, than joints 2, 3 and 4 together ; joints 3 and 4 small and together as long as joint 2 ; 5 very stout, fusiform and as long as 2, 3 and 4 together. The legs have the trochanters stout and long, the tibiæ not quite so long nor so stout as the femora, and with a long tooth ; the tarsi are 3-jointed, with the joints of equal length and with the claws and pulvilli subobsolete. The abdomen is apparently 6-jointed, the basal joint wide, the 2nd narrower, 2—5 increasing in width till 5 is as wide as 1. The ovipositor of ♀ extends a little beyond the apex, and starts from the anterior edge of the 5th joint.

THE DISIPPUS MICROGASTER.—The third parasite which also very commonly infests the last brood of larvæ, and kills its victim during the second period, is a little black four-winged fly belonging to the genus *Microgaster.* The parasitic maggot eats its way out just before the Disippus larva gets ready to build its winter tenement, and spins a pale yellowish cocoon of silk, either upon the back of its victim or upon the leaf close by ; and from this cocoon the fly soon afterwards issues. Figure 73, which represents the Army-worm *Microgaster* enlarged, will convey a good idea of its Disippus relative.

[Fig. 73.]



The genus *Microgaster* is a very extensive one, and the species have not yet been well studied in this country. They are all of small size, and in many instances resemble each other so closely that they can only be satisfactorily studied in connection with their habits and the particular larvæ which they infest. Some appear to confine their attacks to one particular kind of caterpillar, while others infest alike many different species. Thus the one under consideration not only infests the Disippus larva, but I have also bred it from that of the Golden-rod Gall-moth (*Gelechia gallæsolidaginis*, Riley) obtained from Canada ; which indicates it to be a widely distributed species.

MICROGASTER LIMENITIDOS, N. Sp.—♂ ♀. Length 0.09 inch. Color pitchy-black. Antennæ black, about as long as body ; palpi whitish. *Thorax* minutely punctured. *Abdomen* with the two or three basal joints emarginate and rugose, the terminal joints smooth and polished. *Legs* dusky ; front and middle femora yellowish, hind femora black ; front and middle tibiæ yellowish, hind tibiæ with terminal half dusky, but the spur pale ; front and middle tarsi yellowish tipped w h dusky, hind tarsi dusky above, paler below. *Wings* hyaline, iridescent, the nervures and sti a black or dark-brown, the radial nervule, the cubital nervules and the exterior nervule of the s coidal cell, sub-obsolete.

Described from 6 ♀, 1 ♂, bred from larvæ of *Limenitis disippus,* 3 ♀ bred from larvæ of *Gelechia gallæsolidaginis.* In the latter the nervures of wings are paler and less distinct than in the former. Most of our N. A. species of this genus have been described by Mr. Cresson who has seen this and considers it new. It certainly differs from the other described species.

MIMICRY AS ILLUSTRATED BY THESE TWO BUTTERFLIES, WITH SOME REMARKS ON THE THEORY OF NATURAL SELECTION.

The means by which animals are enabled to escape from their enemies and obtain their food, or in other words to sustain themselves in the great struggle for existence that is continually going on between each species, are as varied as they are wonderful. There is generally a conformity of tint between all animals and their surrounding, and in the higher classes Mr. A. R. Wallace has shown* that in general terms it may be stated that desert animals are desert colored, arctic animals white, and nocturnal animals gray, *i. e.*, of such colors as best to accord with the surroundings. Animals, birds, fishes and reptiles come under this rule to a great extent, and the reader will be amply rewarded by perusing the details given in the valuable and interesting work referred to. But in no Class of animals does this principle of adaptation to environment occur so generally and in such a striking manner as in insects. With them mimicry and other protective resemblances are almost universal, and it may be given as a rule that all insects living above ground, when not naturally protected by odor, luminosity or defensive covering such as hairs, spines, hard shelly wings, etc., or by armor such as stings, beaks, etc., either cover themselves with one substance or another, or similate their surroundings, or mimic either other animals, plants, or even inorganic substances. With insects in their larval states, will this rule especially hold good.

What entomologist has not been deceived by the close resemblance of the beetles belonging to the genus *Chlamys* to the dung of caterpillars; or is not familiar with the quaint and close resemblance of the Walking-sticks and Walking-leaves to the objects from which they take their names? Chapter after chapter might be written on these wonderful imitations which deceive the best trained eyes; and there are many most striking instances among our American insects which have never yet been published and which I hope some day to illustrate. But my present purpose is simply to draw attention to the illustration afforded by the two butterflies which we have been considering.

These striking resemblances were formerly looked upon, for the most part, as curious analogies in nature, intended to carry out the

*Contributions to the Theory of Natural Selection.

general plan of the Creator; but viewed in the light of modern science, and especially by that of the Darwinian development hypothesis, they have acquired an immense significance. One of the most interesting phases of this mimicry, and one which has only within the last few years been brought to light, is the imitation by an otherwise defenseless butterfly, of one whose great numbers and wide distribution indicate that it enjoys peculiar advantages. This specific imitation of one butterfly by another is precisely of the same nature as the mimicking of a vegetable or inorganic substance, and may consequently be just as properly termed mimicry. Some authors seem to make a distinction between this so-called mimicry and what is known as "protective resemblance," while others again misconceive the true import of the word "mimicry" as used in this connection. Thus, Maj. J. R. Muhleman in an essay on "Mimicry in Insects," read before the Central Illinois Horticultural Society this winter, gave the word so broad an interpretation as to apply it to the possum-playing of some insects, and even to the supposed and far-fetched resemblances such as that of the female Canker-worm to a plant-louse, and of the female Bag-worm to a Dipterous maggot. True mimicry can only occur where it is of benefit to the species, no matter whether the benefit be derived by enabling harmless species to avoid their enemies in one way or another; or by enabling predaceous species to deceive their prey by assimilating the form and colors of the latter.

As already stated, the particular group to which our Archippus butterfly belongs is a large one, and the species comprising it are very numerous. They are especially abundant in South America, and like our own species, they all possess a pungent odor which seems to pervade all the juices of their system. So much is this the case that according to Mr. Wallace,* when an entomologist "squeezes the breast of one of them between his fingers to kill it, a yellow liquid exudes which stains the skin, and the smell of which can only be got rid of by time and repeated washings." The wings of these butterflies, as may be seen by referring to Figure 63, are rather longer than usual, but their flight is comparatively slow, and they do not dodge and zig-zag about with sudden skips and jerks as the "Skippers," (HESPERIDÆ,) are known to do. They furthermore possess no adaptive coloring to protect them during repose, for they take no pains to hide themselves, and their colors are bright, and those of the under-side as conspicuous as those of the upper.

Hence we cannot assume that they are enabled, by their peculiar mode of flying, to escape to a great extent those cannibal animals that would otherwise catch and devour them; and if we propose to account for their prodigious abundance at all, we are driven to have recourse to some other hypothesis. Indeed, so far is it from being the case that it is their mode of flight which enables them to

*Contributions, etc., p. 78.

escape from their cannibal foes, that Mr. H. W. Bates, the English naturalist, who spent eleven years in the Valley of the Amazon River, studying the natural history of the insects of that region, where this particular group of butterflies is very copiously represented, declares that he never saw a single one of them attacked by any cannibal foe whatever, whether bird, or Dragon-fly, or lizard, or *Asilus*-fly.

It is therefore reasonable to assume that their peculiar odor renders them unpalatable to animals of prey. We have seen that the Archippus butterfly enjoys an almost perfect immunity from the attacks of predaceous animals, consequent, in all probability, upon this peculiar odor which attaches to it both in the larval and perfect states. In this case the supposition is even strengthened by the fact that the only parasite known to attack it is a *Tachina*-fly, belonging to a family which is notoriously defiant of strong odors, the larvæ often rioting in filth and the flies many of them known to be especially attracted to such odors.

Now there is another large group of butterflies, known as the *Pieris* family, to which the white cabbage butterflies belong, which were mentioned in my last Report (pp. 104–110.) This group differs widely in structure from the *Danais* group, and is represented by many species in the Valley of the Amazons; but instead of the species being exceedingly abundant in individuals, as in the case of those belonging to the *Danais* family, it is quite the contrary; the proportion between the number of individuals belonging respectively to two of the commonest genera of either group (*Leptalis* and *Ithomia*) being only 1 to 1000. Hence, it is reasonable to infer that this group must be much persecuted by cannibal foes, and such has been found to be the case.*

The colors found in the species of the *Danais* family are red, yellow, orange, white and black; while only the last two colors obtain in the *Pieris* family, the white being sometimes tinged with greenish yellow. So far so good. We see flitting about in the great Valley of the Amazons, vast swarms of long-winged butterflies, gorgeously dressed in red, orange, yellow, white and black; and certain short-winged butterflies, in very much smaller numbers, whose proper livery is but the plain black and white that befits a funeral. We see the former enjoy an entire immunity from the attacks of all predaceous animals, and the latter snapped up by every hungry bird, Dragon-fly or *Asilus*-fly that happens to come across them. Will it be believed, now, that there are certain particular species of the homely, much persecuted, short-winged group, that assume the livery worn by certain particular species of their gaily dressed compatriots, and actually even copy their elongated wings? Yet such is the indubitable fact. In the Memoir of Mr. Bates, already referred to, will be found

*These facts were first brought to light about nine years ago, by Mr. Bates, in a most interesting and valuable Memoir, published in the Transactions of the Linnæan Society, (Vol. XXIII, p. 495.)

beautiful colored figures, in the highest style of art, both of the species that mimic and of those that are mimicked; and no one that looks at those figures with an unprejudiced eye can believe for a moment that the resemblance is merely accidental.

Even the practiced eye of the entomologist is sometimes deceived by these close resemblances, and to illustrate, I cannot do better than to quote Mr. Bates's own language:

These imitative resemblances, of which hundreds of instances could be cited, are full of interest, and fill us with the greater astonishment the closer we investigate them; for some show a minute and palpably intentional likeness which is perfectly staggering. I have found that those features of the portrait are most attended to by nature, which produce the most effective deception when the insects are seen in nature. The faithfulness of the resemblance, in many cases, is not so striking when they are seen in the cabinet. Although I had daily practice in insect-collecting for many years, and was always on my guard, I was constantly deceived by them when in the woods. (p. 507).

Mr. Bates accounts for these singular cases of mimicry by supposing that, ages and ages ago, certain individuals of this plainly-dressed and much-persecuted *Pieris* family happened to vary slightly so as to resemble slightly some species or other belonging to the gaily-dressed and unpalatable *Danais* family; that, in consequence of this slight resemblance, they were sometimes mistaken for their more fortunate compatriots by cannibal animals, which would otherwise have preyed upon them forthwith; and consequently that they survived long enough to propagate their species, while almost all the individuals that had not varied in this particular manner perished prematurely by a violent death. Now, we know that, in the language of breeders and stock-raisers, "like produces like," which is what naturalists express by the well-known term of the "Law of Inheritance." Hence the descendents of this primordial race of imitative butterflies would naturally, most of them, vary in the same manner as did their ancestors from the normal type; and some of them would probably vary in a still more marked manner and in the same direction. These last individuals, as they would bear a still closer resemblance to the unpalatable butterflies, would of course stand a still better chance of surviving and propagating their species, in the course of that great Struggle for Existence, which we see going on all around us, not only among the inferior animals, but among the human species itself. By the perpetual repetition of this process, during indefinite ages, that perfect imitation of the imitated butterfly would at length be formed, which at first view appears so utterly inexplicable. And when it had once been formed, the very same process that originally formed it would afterwards keep it up to the standard of perfection. For all individuals, that varied in a backward direction towards the primordial type, would be more liable than the rest to be devoured in early life by cannibals, and would therefore be less likely than the rest to propagate their own image in succeeding generations. The whole pro-

cess, indeed, is so beautifully simple and intelligible, that, but for certain prepossessions and prejudices, it would at once command the assent of every logical mind. In fact, it is strictly analogous to the common operation of "rogueing" a bed of seedlings, which every gardener is familiar with. The only difference is that, when the gardener pulls up what he calls the "rogues" out of a thousand seedling tulips, *i. e.*, those which deviate from the standard of perfection which he is aiming to attain, he acts with the definite object of preventing the further propagation of those so-called "rogues;" whereas, when cannibal animals destroy the "rogues" among the imitative butterflies, they are of course perfectly ignorant of the consequences likely to follow, and act wholly and solely for the gratification of their own carnal appetites. In short, the whole phenomenon is explained on the theory of Natural Selection as expounded by Darwin.

Since the publication of Mr. Bates's paper, a great many additional cases of similar mimicry among butterflies have been observed by Mr. Wallace* in the Malayan region of South America, and by Mr. Trimen in South Africa.† But though most of these wonderful cases of mimicry occur in the tropics, where insect development is so rapid and species are so abundant, we also have a striking instance of similar mimicry in our two N. A. butterflies, *Archippus* and *Disippus*. The resemblance between them must long ago have been noticed, for it is so servile that Prof. Jaeger in his *Life of North American Insects*, has actually favored his readers with a figure of the Disippus and gravely informs them that it is the Archippus butterfly. Indeed it is far more striking than my figures would indicate, and in a state of nature the two insects could hardly be distinguished at a short distance by the sharpest eyes. The fact that these two species offer an illustration of similar mimicry to that observed so frequently in the tropics, was first made clear by Mr. Walsh and myself in the *American Entomologist* for June, 1869; and the facts which have since come to my knowledge all tend to confirm the opinion.

The only other species belonging to the same genus as our Disippus butterfly, which occurs in the Mississippi Valley, is the Ursula butterfly‡ (*Limenitis ursula*, Fabr.), an insect which differs remarkably from our Disippus in being of a sombre blue-black color, with its wings bordered both above and below with blue, and below with a series of dull orange spots inside the blue border. Its larva feeds on Willow, Scrub-oak, Whortleberry, Cherry and Plum, and as already stated, has the same habits as that of Disippus, which it resembles so closely as scarcely to be distinguishable. The pupæ of the two species are also undistinguishable.

* See the Chapter on Mimicry among Lepidoptera in his Contributions, etc.

† See his paper on "Mimetic Analogies among African Butterflies," in the Transactions of the Linnæan Society for 1868.

‡ There are seven described species of N. A. *Limenitis*, but with the exception of the two above named they are all confined to the more eastern or western portions of the Continent.

If this Ursula butterfly were placed side by side with the Archippus butterfly, everybody would say at once that no two species could possibly be more unlike in the general style of their coloration. Clearly, therefore, it cannot be considered as in any wise mimicking the latter. Now, the Ursula butterfly is found everywhere throughout the Northern States wherever the Disippus butterfly is met with, and yet, while the latter is a common and abundant species, the former is quite rare. This is certainly the case in the Mississippi Valley, and will, according to my own experience, and that of others* very generally hold true all over the country.

To what are we to attribute this fact? It can scarcely be owing to structural differences in the external organization of the two species; for the two belong to one and the same genus. It surely cannot be because the larvæ of the former are more exposed to the attacks of predaceous animals than those of the latter; for they inhabit the same, or very nearly the same trees, and in size, shape and general coloration the two are almost exactly alike. Certainly it can not be because the pupæ of one species are more subject to be devoured by birds, insects, etc., than those of the other species; for it is impossible to tell one pupa from another when placed side by side. The only cause to which we can reasonably attribute the great abundance of the Disippus butterfly and the comparative rarity of the Ursula butterfly is, that the former mimicks the Archippus butterfly, as has been shown above, and is consequently often mistaken by birds, tree-frogs, Dragon-flies, *Asilus*-flies and other beasts of prey for its unsavory prototype and allowed to escape with impunity, while the latter, having no such disguise, is ruthlessly devoured by every insect-eating animal that can get hold of it.

All the facts lead to such a conclusion. The mimicked species enjoys an almost perfect immunity from the attacks of enemies in all its stages, while the mimicker is persecuted by several. The mimicker is often found in company with the mimicked, as I have myself, and as others have witnessed.† But what is still more conclusive is the fact observed by Mr. S. H. Scudder‡ that in the extreme Southern States where the Disippus butterfly occurs, and Archippus is replaced

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* According to Mr. J. A. Lintner, *Ursula* is "rare" and *Disippus* is found abundantly in New York. (*Proc. Ent. Soc. Phil.*, III., pp. 63–4.) According to Mr. J. Kirkpatrick *Ursula* is "rather rare" and *Disippus* "common in the fall" in Ohio. (*Ibid.*, p. 329.) According to Mr. Sam H. Scudder, *Ursula* is "rather rare" and *Disippus* is "common" in New England. (*Proc. Essex Inst.*, III., p. 165.) According to Mr. Billings, who does not seem to have met with any *Ursula* at all, *Disippus* is "very common from July to October" in Canada West. (*Canad. Entom.*, I., p. 45.) There appear to be some exceptions to this rule, however, for Mr. Thos. W Higginson, of Newport, R. I., declares (*Am. Entomologist*, II., p. 177.) that *Ursula* is one of the commonest of the large butterflies there and decidedly more so than *Disippus*. I was also informed while at Troy last fall, that the former outnumbered the latter in the vicinity of New York City in the year 1868, though the previous years it had been quite rare. These exceptions to the rule may be owing to one cause or another, but I shall attempt to explain them when I come to consider the objections to the theory which I espouse.

† Mrs. Mary Treat, of Vineland, N. J., writes that *Archippus* was unusually abundant there last fall, and that she found *Disippus* in company with it.

‡ *Nature*, Vol. III, p. 147.

by the Berenice butterfly—a species of the same genus and of similar appearance but of darker color—the color of the mimetic Disippus deepens nearly or quite to the tint of the Southern *Danais*. Thus it is that facts before unintelligible are explained by Darwinism!

In a discussion on the difficulties of Natural Selection, which took place in late numbers of the London journal *Nature*, some ingenious objections have been urged. As many of them have especial reference to the mimicry we have been noticing, a brief summary of these objections will prove interesting in this connection, the more especially as all objections must in the end only serve to strengthen a theory, if that theory is sound.

Mr. Alfred W. Bennett* undertakes to show upon mathematical considerations, that Natural Selection could not produce these mimetic forms. He assumes that it would take 1000 steps to enable the normal form of a *Leptalis* for instance, to pass into the protective form of an *Ithomia*; that no change less than one-fiftieth of the whole alteration—*i. e.* 20 steps—would be of any use to the insect, and that the alterations in the early stages, being useless to the animal, would not be preserved, and even if they were, could not be attributed to Natural Selection, but to an accumulation of chances. He reiterates what has already been well shown and acknowledged by Darwinians, namely, that Natural Selection cannot produce the first change, and asks with good reason why the same principle that works the first change should not also work the subsequent changes? He does not dispute the secondary power of Natural Selection, but believes in an unconscious organizing intelligence which co-operates with it to produce the mimetic results. He endeavors to strengthen his position by showing that there is a close connection between instinct and mimicry, and ventures the theory that "the power of mimetism, so far as is known at present, runs almost *pari passu* with the development of the nervous system."

The essay is an able and interesting one, and the arguments are skillful and ingenious. It pays due and just respect to Darwinism and forcibly presents the fact, which no one has denied, that some other power than natural selection acts in producing first change The mathematical argument, however, will have little weight with those who fully appreciate the changes in Lepidoptera that take place in nature. No entomologist who has had any experience in rearing Lepidoptera will admit with Mr. Bennett that 1000 steps are necessary to produce mimetic resemblance, and when this foundation stone of his objection is taken away, much of his other reasoning which is built upon it becomes weak. Instances of great and sudden variation among butterflies and more particularly among moths are by

* *Nature*, Vol. III, pp. 30–33.

no means rare. In this Report instances of great variation in species have been given, and hundreds of others might be cited.*

Mr. Bennett furthermore, as Mr. Wallace subsequently pointed out,† fails to take into consideration the fact that each butterfly produces not only one, but numerous offspring, that the right variation has, by the hypothesis which he combats, a greater chance of surviving than the rest, and that at each succeeding generation, the influence of heredity becomes more and more powerful, causing the chance of the right variation to become greater and greater. He also appears to forget that this imitation in butterflies is of comparatively rare occurrence, and that the mimickers generally belong to genera which naturally show a tendency to depart from the normal coloring of their own family and to approach that of the mimicked, so that the first steps are greatly facilitated. I consider therefore that the mathematical objection utterly falls to the ground; but that there is something in the closing ideas which Mr. Bennett throws out, which may yet lead to important discoveries, I can very well conceive. Indeed it must be rash to deny some such influence as he describes when we reflect upon the extraordinary power which the mind of the mother exerts, during pregnancy, on her offspring; and when we further consider that Mr. Wallace himself admits that man's present mental and physical condition could not have been brought about by natural selection alone. It must be obvious to every one, however, that such an admission is no argument against the theory of Natural Selection. All other modifying influences though they may lessen her potency simply assist her in her grand work.

The next objector we find in Mr. Saml. H. Scudder of Boston, Mass.,‡ who, while admitting that there can be no possible doubt of the fact of mimicry, questions its advantage among butterflies, since the greatest destruction occurs in their preparatory states. But as he refers especially to the two butterflies we have been treating of and as from the context it appears that he is also aware of the existence of some of the parasites which I have described, I will quote the greater portion of his letter which was written from Cairo, Egypt, under date of November 9th, 1870; and, will afterwards reply to his objections:

"But of how much actual benefit to the mimetic species is this so-called "protective" resemblance? It seems to occur where it can be of the least possible advantage to the species. The great sources of destruction here, as in all groups of animals, are in early life. How large a proportion of the eggs that are laid by butterflies ever finally produce imagines? Let those answer who have attempted to follow their history in their native haunts. My experience leads me to believe that at the very least, nine-tenths—perhaps ninety-nine hundredths—never reach maturity. Hymenop-

*A most remarkable case came under my notice the past summer. From a single batch of flattened and ribbed eggs, overlapping each other under a piece of Hickory bark, I succeeded in raising eighteen imagines of *Catocala phalangea*, Guen. The upper wings vary greatly in the individuals, and in one specimen the ground-color and markings are so very aberrant, that there is more difference between it and some of the others belonging to the same batch, than there is between the latter and a dozen distinct species.

†*Nature*, III, p. 49.

‡*Ibid*, Vol. III, p. 147.

terous and Dipterous parasites beset them at every step. The eggs, although so small and often so heavily ridged, cannot escape the ovipositors of the tiny Pteromali, while in attempting to breed caterpillars taken in the field, the chance is so greatly against the evolution of a butterfly, that Hymenopterists actually choose this method of supplying their cabinets. 'Of two hundred larvæ of *Pieris brassicæ,*' Mr. Drewsen, of Denmark, writes to me, 'I obtained only twenty pupæ, all the rest were attacked by *Microgaster glomeratus,* and my own attempts with the larvæ of *Pyrameis Atalanta,* both in America and Europe, have been even more unavailing. These caterpillars seem to be peripatetic banqueting halls of Microgasters and Tachinæ.

"Now it is a curious fact that while the globular egg of *Limenitis Misippus,** with its deeply-pitted shell, defended by long filamentous spines, is constantly attacked by parasites; and the grotesque hump-backed, strangely-colored caterpillar of the same species is likewise infested to an extraordinary degree, I have been unable to discover by very careful search any evidence that the egg or larva of *Danais Archippus* is ever pierced by a parasite; yet the egg is not small and only lightly ribbed, and the caterpillar large, fleshy, smooth-skinned, and gaily banded, living on the widely-separated leaves of Asclepias, with no attempt at concealment. The abundance of the imago of the Danais is then due quite as much to the immunity of the egg and larva from the attacks of parasites, as to any freedom it may itself enjoy from pursuit by insectivorous birds. [1.]

"Although I have hunted butterflies for fifteen years, I confess I have never seen one in a bird's bill, and my faith in that method of lessening their numbers is very slight. Birds, too, must be their greater foes in earlier life; and the chances of living, which are certainly against them before they take wing, seem afterwards rather in their favour, at least, until they have accomplished their mission. [2.]

"If, then, such an extraordinary element as Mimicry is to be summoned to the aid of Natural Selection, and can perform its task in such a masterly manner, why has it been made to waste its energies upon unimportant material? If the object of the resemblance be protection, why does not the unfortunate caterpillar of the Limenitis mimic the more favoured larva of the Danais? [3.]

"I cannot now consult the writings of Messrs. Wallace and Bates, nor do I remember their statements respecting the abundance of the mimetic species compared to that of its normal congeners. In my own country *Limenitis Misippus* is, as a general rule, more common than *L. Ursula,* but the difference in their numbers is not very marked. It is by no means as great as one would expect had Mimicry in the imago state so strong a protective power as has been assumed. [4.] Two closely allied species occupying the same geographical area, do not often occur in the same abundance, whatever be the cause, and the disparity in numbers in these two species of Limenitis is no greate than occurs in many instances where mimicry plays no part. [5.]"

[1.] No one will deny the facts, after what I have already set forth.

[2.] Such an experience from a butterfly hunter surprises me Individually I have on several occasions seen butterflies captured by birds, and have seen Dragon-flies dart after them. Any amount of evidence might be collected on this head, and Mr. Scudder has already been answered by Mr. Arthur G. Butler† of the British Museum, who mentions often having seen birds catch and devour the unprotected species upon the wing, while he has received abundant evidence respecting the immunity of the *Danais* group. "T. G. B." of St Johns College, Cambridge, has also often seen the common English sparrow capture *Vanessa urticæ* and *Pieris rapæ*‡; while Mr. Wallace has shown that great numbers of butterflies are destroyed on the wing by insectivorous birds such as jacamars, trogons and puff-birds, and gives conclusive evidence that while our Disippus congeners, the *Nymphalidæ,* suffer such persecution, the Archippus congeners do not.§ Thus, though there

*The reader must bear in mind that *Misippus* is but a synonym for *Disippus.*

† *Nature* III, p. 165.

‡ *Ibid,* p. 166.

§ Contributions, etc., p. 79.

seems to be no record of any person having actually seen a bird or other animal attack the species of *Limenitis* in this country, there is every reason to believe that they will do so. This fact once being admitted, it must also be admitted that the resemblance of *Disippus* to *Archippus* serves the former as a protection. I freely grant however, that the species of *Limenitis* are kept under by enemies far more in the preparatory states than in the perfect state; but this fact only adds importance to the mimicry of *Disippus* as throwing light upon its greater numbers. The larvæ and pupæ of *Ursula* and *Disippus* so closely resemble each other that it is not likely their enemies would make any discrimination between them; and if in a given district where *Archippus* is abundant, the two former species, by the undue multiplication of their enemies in some particular year, should be so thinned out while in the immature states, that only a dozen imagines of each were perfected in an area of say 100 square miles; it becomes obvious that by deceiving the birds, or by associating with *Archippus*, the twelve specimens of *Disippus* would stand a much better chance of escape than those of *Ursula*, and that consequently more would succeed in perpetuating the species.

[3.] Natural Selection *does not*, therefore, waste its energies upon unimportant material, in giving protection to the perfect insect; and any one, with a little reflection, will perceive that there are the best of reasons why the unfortunate caterpillar of *Limenitis* cannot mimic the more favored larva of *Danais*. *They never come in contact!* The perfect insects are enabled by flight to associate together; but their larvæ—the one being confined to plants of the Willow and Poplar families, the other strictly to those of the Milkweed family—can never so associate. That there is, however, an effort at protection in the preparatory stages of *Limenitis*, no entomologist who has studied them in the field will deny. The egg, as Mr. Scudder has admitted, is in a measure protected by the long filamentous spines, which may protect it from the attacks of some of the very numerous parasites that might otherwise aid in exterminating it. The larva is very variable, and wears a remarkable protective resemblance to its surroundings. I have often noticed that in the mature specimens found on the dark Scrub willow the dark colors predominate; that those found on Golden willow are much brighter and greener, and the palest specimen I ever saw was found upon Silver poplar. Only those who have diligently searched for these larva can fully appreciate the protection which their appearance affords. In one instance I chanced to espy a large full grown specimen of *Disippus* on a Golden willow not more than seven feet high. The specimen on account of its brightness and greenness struck me as remarkable, and I searched for others. In taking a casual glance I could detect none, but after a diligent search I succeeded in finding seven specimens, and then left, fully convinced that I had espied every one upon the tree. The next day, however, my confidence in the sharpness of my eyes was

considerably shaken, for upon returning to the same small tree I succeeded in finding three more, all of them more than half grown.

As to the chrysalis, it bears a very strong resemblance to a bit of bird dung, and for the first few hours of its being, while the parts are yet soft and elongated this resemblance is truly striking.

[4.] I have shown that the disparity in numbers between *Disippus* and *Ursula* is very marked in the Mississippi Valley, and there is every reason to believe that the former is most abundant wherever its protector, the Archippus butterfly, abounds. I have Mr. Scudder's own authority for the statement that the latter is comparatively rare in the northeastern States, and my own experience would indicate such to be the case. Now it is extremely probable that where *Archippus* abounds, birds and other natural enemies are continually reminded of its nauseous qualities both by smell and taste.*

It would very naturally follow therefore, that where *Archippus* is rare, birds would not be so continually warned of its evil properties, and the deceptive resemblance in Disippus would lose much of its protective power in such a case. This explanation of the fact that *Ursula* is in some districts more common than *Disippus* will acquire greater force, if we find that such a state of things occurs only where *Archippus* is rare, and the facts as they at present stand indicate such to be the case.

Mr. Wallace† is inclined to account for the fact that *Ursula* is in some districts as numerous, or more so than *Disippus*, on the supposition that *Ursula* is also a mimicker, resembling the Philenor swallowtail (*Papilio philenor*, Drury‡) especially on the underside, which is exposed when the insects are at rest. We must, however, be very cautious in accepting such resemblances as cases of mimicry, without first ascertaining whether there can be any real cause for mimicry or whether the two butterflies ever associate together. Under the circumstances I incline to believe that the markings on the underside of *Ursula* are of a generic character since they obtain in other N. A., species of *Liminitis*; and that the resemblance to *P. philenor* is merely casual and bears no more relation to mimicry than does the close resemblance of certain plants belonging to different continents. *P. philenor* is itself a rare insect where *Ursula* is common, and must always be so on account of the scarcity of its food-plant; and, if anything, *Ursula* bears a greater general resemblance to *P. troilus*, Linn, and *P. asterias*, Drury, which are both more common species. It also bears a greater resemblance upon the upper surface to the female of *Argynnis Diana*, Cramer.

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*A singular fact bearing on this point has been communicated to me by Mr. Otto Lugger of Chicago, a gentleman who takes much interest in entomology and is a good collector. While employed on the U. S. Lake Survey he once saw a bird dart after an Archippus butterfly, seize it and immediately drop it without devouring the body. The butterfly dropped close by his side and he picked it up and examined it, and had no means at the time of accounting for the singular action of the bird.

† *Nature* III, p. 166.

‡ See my 2nd Rep. Fig. 86.

[5] This in no wise alters the fact, however, of the existence of mimicry in *Disippus*, which Mr. Scudder fully admits. It is, therefore no argument against Natural Selection having produced such mimicry. Because we are able to explain the principle power working to produce the relative abundance of one species, compared with another that is closely allied, it does not follow that we must also give the varied influences which cause the relative abundance or rarity of other species in other groups!

The third objector is Mr. A. Murray, who undertakes to show that these mimetic resemblances have nothing to do with Nnaural Selection.* He takes it upon himself to assert that every inch of ground which Mr. Bates has gone over is "mined and unsound"—that the "bad smell has not been observed in North America where similar mimicry occurs"; and that "birds and insects of prey hunt by sight and not by smell." Any one who will take the trouble to carefully read the paper in which these assertions occur, will, I have little doubt-come to the conclusion that it is the author's ground which is "mined and unsound." The second assertion, as I have already shown, is false; and even if the third is admitted, it does not in the least affect the argument in favor of Natural Selection, because the fact nevertheless remains that some groups do enjoy immunity from the attacks of birds while others do not. The manner in which Mr. Murray would account for this mimicry is by hybridization, and he endeavors to draw a parallel between the phenomenon and hybridization in plants. He carries little weight in his arguments, which were in a measure anticipated by Mr. Bates himself, and have since been refuted by Mr. Butler and Mr. Wallace.† He forgets that hybridization cannot play any part in the mimicry of insects to the vegetable kingdom, or to backgrounds generally. It has never been known to occur between insects of different Orders, families, or even genera, and produce fertile offspring,‡ while mimicry does occur even between insects of distinct Orders; and though he of course supposes the hybridization to have taken place at a very remote date, when the structural characters of the mimickers and mimicked were less specialized, yet had such been the case, these structural characters would not now remain so distinct between them, because it is quite fair to suppose that the hybrids would partake of the characters of each parent. Indeed the assumption of the theory is unsupported by facts. He ignores in a measure the great difference in the affinities of species belonging to the natural Orders of plants, and those belonging to the Orders of insects, and depreciates the importance of the latter by comparing the Orders

**Nature* III, pp. 154-6.

†*Ibid.*, III, p. 165.

‡Cases of hybridization even between species of the same genus are very rare, and it is doubtful if the hybrids would ever be fertile; and as to hybrids between genera I do not think a case has ever been recorded. In 1865 I succeeded in obtaining thorough coitus between a ♂ *Attacus cynthia*, Hubn., and ♀ *Attacus cecropia*, Linn., but for some reason the eggs resulting from this intercourse did not hatch. Last year I succeeded in producing an equally thorough coitus between a ♂ *Attacus cecropia*, Linn., and a ♀ *Attacus polyphemus*, Linn., but the eggs subsequently deposited by the latter were likewise infertile.

simply to families in other animals—thus showing that he has not a due appreciation of the true affinities of insects.

It must not be forgotten that Natural Selection is not the only power at work producing this mimicry. This we do not claim. There is an inherent tendency in all things to vary—a fact universally admitted. We may not be able to fully comprehend the causes producing this first variation, for they are complicated, and depend on numerous external conditions, and physical and mental influences. But our ignorance in this respect does not affect the theory, because "spontaneous" change is the material out of which Natural Selection has fixed and perfected the mimicry and adaptation; and it is not necessary to know how the "spontaneous" change is produced to learn the origin of the mimicry. Whatever be the causes of variation, and whether or not they continue to act after the first change takes place, Natural Selection is still potent, for the change would be perfectly inoperative in producing specific character without it.

There may be a hundred different influences that have led *Disippus* to mimic *Archippus*. The resemblance being purely colorational, there may have been a tendency from the first in the color of the former to approach that of the latter, and this is rendered very probable from the fact that the red-brown color occurs more or less in all the N. A. species of the genus.*

The very smell which protects *Archippus* may have had, and may still have, attractions for its mimicker, for Mr. Henry Edwards found that a Californian species of the same genus (*Limenitis Bredowii*) was greatly attracted by any offensive odor.† Again, when we reflect that we owe so many of our flowers and fruits to what are called "sports," which are simply instances of great and sudden variation; it is not difficult to imagine that the mimicry of *Disippus* may be due in a measure to some such sudden original variation—an idea that is greatly strengthened by the fact that instances of such great variation are common with butterflies and moths, and that one is known to occur in the very genus *Limenitis*.‡

We may give due weight to the somewhat Lamarckian theory advanced by Mr. Bennett; we may attach the greatest importance to the influence of physical conditions—and we know that similar habitat sometimes produces modification of allied forms in a similar direc-

* In the seven described N. A. species of *Limenitis*, namely, *L. disippus*, Godt., *Ursula*, Fabr., *Proserpina*, Edw., *Weidemeyerii*, Edw., *Arthemis*, Drury, *Lorquini*, Boisd. and *Bredowii*, Hubn. the red color obtains more or less in all of them, especially on the under side, and this is more particularly the case in the last two. I also possess specimens of *Ursula* in which a very distinct shade of red blends with the blue-black and spreads over the upper surface of the primaries, and is in two individuals quite marked towards the apices. That the blue and black is closely connected with, and shows a tendency to affiliate with the brick-red and black, or *vice versa*, we may also reasonably infer from the wonderful contrast existing between the ♂ and ♀ *Argynnis Diana*, Cram., the former colors obtaining in the ♀ and the latter in the ♂.

† *Butterflies of North America*, by Wm. H. Edwards. It is impossible to make any explicit reference to this beautiful work as it is not paged: this, to my mind, is a deplorable oversight.

‡ *Limenitis Sibylla* figured in "Newman's English Butterflies," and referred to by S. N. Carvalho, Jr., in *Nature*, Vol. III, p. 66.

tion—but all these agencies will not produce specific imitation of one species by another, for they only prepare the way for it. It is therefore quite evident that such imitation can only be brought about to use Mr. Bennett's own words, "by the continuous preservation, through countless generations of those individuals which spontaneously approach most nearly to the ultimate forms;" and Natural Selection is the Preserver.

I have thus endeavored to frankly consider the objections raised against the theory of Natural Selection, as it applies to the mimicry of our two N. A. butterflies. It would be out of place here, and might justly be considered a work of supererogation on my part to undertake to defend it on more general grounds. It has been so well developed by Darwin, Wallace, Bates, and many other writers, both English, French and German, that it only asks a hearing to be understood and appreciated. The rapid increase of organisms is demonstrable, and the consequent struggle for existence, since, all organisms considered, there are as many deaths as births, is manifest. The result of this struggle is the survival of the fittest, by which organic forms are constantly changing to keep in harmony with the changed conditions which it is demonstrable have taken place, and are still taking place, in the inorganic world. And, to use Wallace's language, "as the changes of conditions are permanent changes in the sense of not reverting back to identical previous conditions, the changes of organic forms must be in the same sense permanent, and thus originate species."

That its influence and importance has been overrated by some writers is not at all unlikely, for Mr. Darwin himself now believes that he at first attributed too much to its action; and certain it is that it could have had no influence in producing many purely ornamental features of certain animals, that are of no use to the species thus ornamented. No theory was ever yet propounded, however, which has so well stood the test of scientific investigation in all departments of research, or that has such a power of absorbing new facts; and no theory has in such a short time been so very generally accepted by the leading scientific minds.

A two-fold reason has led me to give it prominence in this Report. First, I believe that when well understood it must prove of the utmost importance to the husbandman, by giving him an intelligent conception of the growth and development of animal and plant life about him, and by adding zest and interest to his efforts to produce superior varieties and breeds. Secondly, my studies of insect life led me several years ago to appreciate the hypothesis, and the more I become acquainted with these tiny beings in the field, the more I become convinced of its truth and importance. It is not to be wondered at that the entomologist who treats the different varieties in any group as independent species, should have implicit faith in the absolute distinctness and immutability of species; but whenever he pays more attention to

the biological part of his science, and studies insects more in the field, his views must necessarily change. Indeed, next to plants, insects offer, perhaps, the best material for the inquiring mind to work upon. Their rapid multiplication, the rapid manner in which one generation is often followed by another, the wonderful manner in which they are often affected by climate and food, especially during the preparatory or adolescent stages—all tend to furnish variation for Natural Selection to work upon, in a profusion unknown in the higher animals. Though the formation of a species in the other Classes of animals may never be in man's power to trace, on account of the great lapse of time required; it seems highly probable that the process may some day be traced in insects, and Mr. Bates gives strong proof of the derivation of one butterfly (*Heliconius thelxiope*) from another (*Heliconius melpomene*) and a clear insight into the manner in which the gradual modifications take place, till at last the two forms cease to interbreed, and are in every sense of the word true species.*

After all, the great objection to the theory of Natural Selection, in the minds of many, is, that it involves belief in the broader doctrine of Development—of Evolution. Very true! But, no matter how much importance be attached to Natural Selection, the fundamental truth of the development of species is now almost universally accepted by scientific men best able to judge of its merits; and those who have not considered the subject may be excused from judging of it. Indeed it can hardly any longer be considered a hypothesis: it is in reality established as a law, and as eminent a naturalist as Carl Vogt has even ventured the assertion that "no one in Europe dares any longer sustain the independent and direct creation of species." Development is a fact in nature, and the revelations of science strengthen faith in the universality of her laws and principles. No one can study well the facts in natural science, or the truths of philology, which point to corresponding results, without feeling more strongly than ever words can express, the general truth of the doctrine. Our own Agassiz is about the only great naturalist who opposes it, though it is rather significant that many of his leading pupils have, within the last few years, boldly proclaimed their faith in Darwinism. If there is one error in Agassiz' life, I take it to be the authority which he has lent to that popular prejudice which has always opposed inquiry into the order of nature, and which has ignorantly accused Darwin of atheism.

A theory which is so opposed to deep-set tradition and to present theological interpretations, must necessarily at first meet with very great objection. Such has been the history of all great scientific truths, for we have Agassiz' own words that "the history of the sciences is present to tell us that there are few of the great truths now recognized which have not been treated

*Naturalist on the River Amazons, Vol. 1, pp. 255–265.

as chimerical and blasphemous before they were demonstrated.' Truth must, however, in the end prevail!

Science and theology have little in common, and will, perhaps, always be at variance, but science and true religion are twin-sisters, and will ever go hand in hand. In the present question, theology affirms supernatural causes beyond man's investigation, and consequently sets an embargo on inquiry; while science affirms natural causes within the limits of investigation: the one appeals to man's senses, the other appeals to man's reason, whose throne should never be abdicated, and whose power to trace effects to antecedent causes is unlimited.

The belief that Darwinism is irreligious and atheistic, is widespread; but this belief is the direct result of prejudging and unfounded prejudice. For no one who understands the theory can entertain such an idea for a moment. The individual is not created by a special miracle, but develops by natural means. Yet no one would claim that the individual was any the less a creation. And so when it is argued that species also develop by natural means—according to natural law; they are none the less therefore creations! It is only a question as to the method which the Almighty employs; for not only does the development hypothesis imply an Infinite cause, but to use Prof. E. L. Youman's language "its conception is as much grander than the common theological idea, as the conception of the Cosmos which science has revealed, transcends the petty ideas of the world which were entertained in the grovelling infancy of the race!" Creation by a process of development is tangible and conceivable, whereas we can have no knowledge and no conception of creation without any process.

Haeckel, one of Darwin's strongest supporters, says: "In recognizing the unity of nature and the efficacy of the Divine Spirit in everything, we may perhaps lose the hypothesis of a personal Creator, but we evidently gain the idea of a Divine Spirit, which pervades the whole universe. God is the highest, the most living, the most active unit through all things which only appear as sensuous representatives for sensuous creatures." Can such men be called atheists or materialists?

The supposition that the creative mind produced all things as we now find them, by a single act of unstinted power, requiring only such time as can be reckoned by ourselves, is the direct outgrowth of our own comparatively feeble minds—is to gauge the power of the Almighty by our own. The supposition that he works through natural law, originally ordained, and by a constant exercise of his prerogative, is a far higher and more comprehensive conception; for it helps to broaden our views and enables us to grasp something more than we have hitherto done. It carries us back æons in the past, and shows us that creation has not only been continuous but still endures, and it

helps us to rise to sublimest contemplation of that unknown Infinity which pervades all.

Von Baer has truly remarked that "the scientific investigation of Nature strives to learn everything in detail, in order to get nearer to the cause of everything," and though we may not always reach the goal we aim at, we should not therefore cease to try. The law of the age is progress, and the point we reach to-day will form our starting point to-morrow. Every step which enables us to more truly interpret the workings of the Divine Mind in nature, necessarily brings us nearer to, and gives us a more intelligent idea, of a Creator. Each new insight into the significances and harmonies around us, helps us to lift the mystic veil and behold with awe and wonder the might and majesty of God—to converse with him as flesh with unknown Infinity; and I look forward to the day when the development of species will not only be universally recognized as a law, among naturalists; but when the liberal-minded theologian will revere the names of men like Darwin, who help to a higher conception of creation—instead of anathematizing them and ignorantly charging to their doctrines those atheistic tendencies which in times past have been vainly thrown up to those of so many other great, clear-thinking, discovering minds!

ERRATA.

Page 7, line 18 from bottom, for "*Hyleœctus*," read "*Hylecœtus*."
Page 57, line 18, add "*c*" before the first "*h*."
Page 58, line 2 from bottom, for "*fornudolosus*" read "*formidolosus*."

ERRATA OMITTED IN THE FIRST REPORT.

Page 14, line 16 from bottom, for "females" read "males." Page 30, note, for "F" read "T." Page 32, line 14 from bottom, for "III" read "V;" same page, line 7 from bottom, for "XIII" read "VIII." Page 38, line 5, for "*Tredeim*" read "*Tredecim*." Page 53, line 19 from bottom, for "laid" read "lain." Page 54, line 4 from bottom, for "hatch" read "are deposited." Page 87, line 11 from bottom, for "F" read "T." Page 132, line 16, for "*ampelopsis*" read "*ampelopsidos*." Page 150, line 6, for "ruddy" read "vigorous;" same page, line 26, for "*thyridopteryx* read "*thyridopterygis*." Page 154, in the heading, for "*zeas*" read "*zeæ*." Page 155, line 13 from bottom, for "zeas" read "zeæ." Page 173, line 3 from bottom, for "it" read "the more liquid parts;" same page, under the heading, read ("Lepidoptera, Tineidæ.") Page 174, line 3 from bottom, for "*Solidaga*" read "*Solidago*." Page 175, line 32, add "front" before "wing." Page 178, lines 2 and 3, for "*gelechia*" read "*gelechiæ*."

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